



GUIDELINE

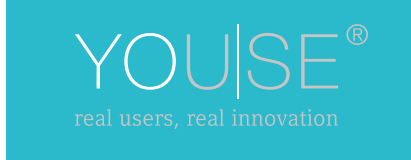
THE ART AND JOY OF USER INTEGRATION IN AAL PROJECTS



**White paper for the integration of users in AAL projects,
from idea creation to product testing and business model development**

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About Ambient Assisted Living Association:

The Ambient Assisted Living Association is organizing the Ambient Assisted Living Joint Programme (AAL JP). The AAL JP aims at enhancing the quality of life of older people and strengthening the industrial base in Europe through the use of Information and Communication Technologies (ICT). Therefore, the AAL JP is an activity that operates in the field of services and actions to enable active ageing among the population.

The programme is financed by the European Commission and the 22 countries that constitute the Partner States of this Joint Programme.

See more at: <http://www.aal-europe.eu/>

About YOUSE:

YOUSE supports companies and research projects with its expertise in user experience design, usability engineering, user testing and user integration. Based on its user-centred design approach, YOUSE helps to develop innovative products, better and smarter services, user-friendly packaging and manuals, especially for the ‘generation plus’.

YOUSE has worked in various AAL projects and offers its services - together with its panel of “senior innovators” - at its two locations Munich and Berlin, Germany. The company is managed by Dr. Christoph Nedopil and Dr.-Ing. Sebastian Glende.

See more at: <http://www.youse.de/en>

SUMMARY

Know what your user integration goals are. Have a clear idea of what you want to achieve with the user integration. Without a clear goal, you might discover wonderful things, but fail to resolve the actual problem at hand.

Ask the right questions. If you need information about the users, you have to ask the right questions. Asking about a product improvement (e.g. of a vacuum cleaner) differs from asking for ideas to solve a problem (e.g. to have a clean house).

Don't re-invent the wheel. There is no need to research what others have researched before. Look for secondary data before you start doing primary research. Thereafter you can focus your primary research on new issues.

Plan your user integration process early. Have a clear understanding of how you want to research user needs through user integration. Timing is crucial from a development point of view (e.g. when ideas are needed or when testing is needed) and from a user recruitment point of view. Senior users are often more busy than one might expect.

Integrate the right users. If you want to learn something from users, you have to decide from whom you want to learn: Integrate users with a lot of ICT experience ('lead users') with idea creation phases; integrate users who are at high risk of making errors when using a solution in the testing phases.

Don't make user integration a democratic exercise. A majority does not usually suggest the best ideas or identify the biggest problems, individuals do. It is the expert's (i.e. your) task to select the best ideas and most relevant problems.

Don't let the loudest voice win. The person involved in user integration, who has the strongest opinion or the loudest voice, does not necessarily have the right or the best opinion. Listen to all users and encourage them to voice their ideas. You must select the solution with the most potential.

Know which methods to use. Understand different user integration methods' potentials and limits. Only by choosing a method that helps you answer your question with the users you invited, will you be able to understand what they really want or fear.

Think about the business model from the beginning. Understand what the added value of your Ambient Assisted Living (AAL) solution is from the beginning and try to develop it accordingly. There is no need for a new solution if it offers no additional benefits.

Integrate paying parties (e.g. tertiary users) from the beginning. Try to understand the needs of those who might pay for the solution as early as possible. Although AAL solutions are socially desirable, they can only unfold their true potential if they are also affordable.

Make your innovation process iterative. Try to create ideas, develop prototypes of partial solutions, test them, and improve them. Don't wait until the final prototype is ready to test, but test continuously to ensure steady improvements.

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1 INTRODUCTION

Integrating users into the innovation process is a great way to create an outstanding product - and to waste resources. By integrating users into innovation processes, new products can be created that meet their needs and improve on the engineer's ideas. However, integrating users can be a self-fulfilling science, with the process becoming the goal rather than a means to an end. This happens, for example, when an increasing number of users are integrated in order to research a design decision, but a lot of contradicting information is gathered, which then complicates the decision.

Therefore, the goal of user integration is not to eliminate uncertainty in inherently risky new product developments, but to minimise the risks and increase the chances of success. User integration can increase market success if Ambient Assisted Living (AAL) solutions are changed to meet the target group's actual needs from the beginning, since developers and users of AAL technology often differ significantly with regard to age, technology expertise, or lifestyle. The purpose of this guideline is to help AAL projects optimise their user integration process in order to

- better understand user needs
- test solutions to ensure usability, ease of use and an impact on the quality of life (QoL) and
- develop new and fresh ideas for a great overall user experience (including emotional experiences regarding AAL use)

as outlined in the AAL JP 'Guide for Applicants'¹ (see Chapter 12 on the status of end-user involvement in submitting a project proposal to the AAL JP calls).

This guideline for user integration supports the User Integration Toolbox, a set of method cards for user integration available on the Ambient Assisted Living Association's website.

1.1 STRUCTURE OF THIS GUIDELINE

The guideline is structured as follows: The next section will define a typical innovation process and look at those phases where user integration has the biggest impact. Chapter 2 discusses user integration as an important part of a user-centred design process and analyses its benefits and limits. Chapter 3 looks at user integration in practice. It covers aspects that should be considered when performing user integration and the user integration methods that should be used in the different innovation phases. Chapter 4 introduces other methods of user-centred design, such as personas and heuristics (methods enabling the developers to make design choices according to rules). Chapter 5 discusses the ideal user-centred design process, while Chapter 6 summarises the guideline.

¹ www.aal-europe.eu/wp-content/uploads/2013/04/Guide_for_Applicants_20130416.pdf

1.2 THE DIFFERENT PHASES OF USER-CENTRED DESIGN

No Ambient Assisted Living (AAL) projects are alike: They differ with regard to their development goals, their main target group(s) and their specific innovation process. However, all AAL projects share a basic innovation process that including three basic phases (see **Figure 1**):

- 1) **Understanding:** Gathering information about the target groups (requirements, characteristics, daily routines, etc.), the potential benefits of technologies, and the technological state-of-the-art.
- 2) **Conceptualising:** Specifying the use cases, the details of the technology, and the assumed benefits for the target groups.
- 3) **Testing:** Testing single components or the complete concept/system for usability and the assumed benefits.

Business Modelling can be regarded as a parallel phase that focuses on the marketing strategy's general alignment with the target group's needs and values rather than the product details. It involves, for instance, an analysis of important AAL solution stakeholders², the development of a marketing strategy, and an analysis of the users' willingness to pay for an AAL system. Business modelling activities should be undertaken during the other three phases. These activities should start right at the beginning of the user-centred design process. The methods for developing user-friendly business models are the same as for creating user-friendly products (e.g. focus groups and interviews).

Most projects won't experience all these phases in this exact order, as previous projects might have gained insights in previous innovation projects or innovation phases (e.g. testing an application that is part of the AAL solution), or because information can be drawn from a literature research (e.g. understanding the users' daily routines). These phases can also be applied to different project levels in order to create a concept of the complete AAL solution instead of designing a single component such as the interface. Consequently, this model is introduced to understand and structure a development process, but is not necessarily a perfect blueprint for all innovation processes.

The following sections take a closer look at user integration during phase 1 – Understanding, phase 2 – Conceptualization, phase 3 – Testing, and at the Business Modelling aspects.

² Primary stakeholders are the persons using the AAL solution as an end-user in the first place, secondary stakeholders are persons, companies, and organisations that are accessing or using AAL solutions for the benefit of primary end-users, and tertiary stakeholders are institutions and organisations who play a role in providing, financing or enabling them (see the knowledge base for a more detailed definition).

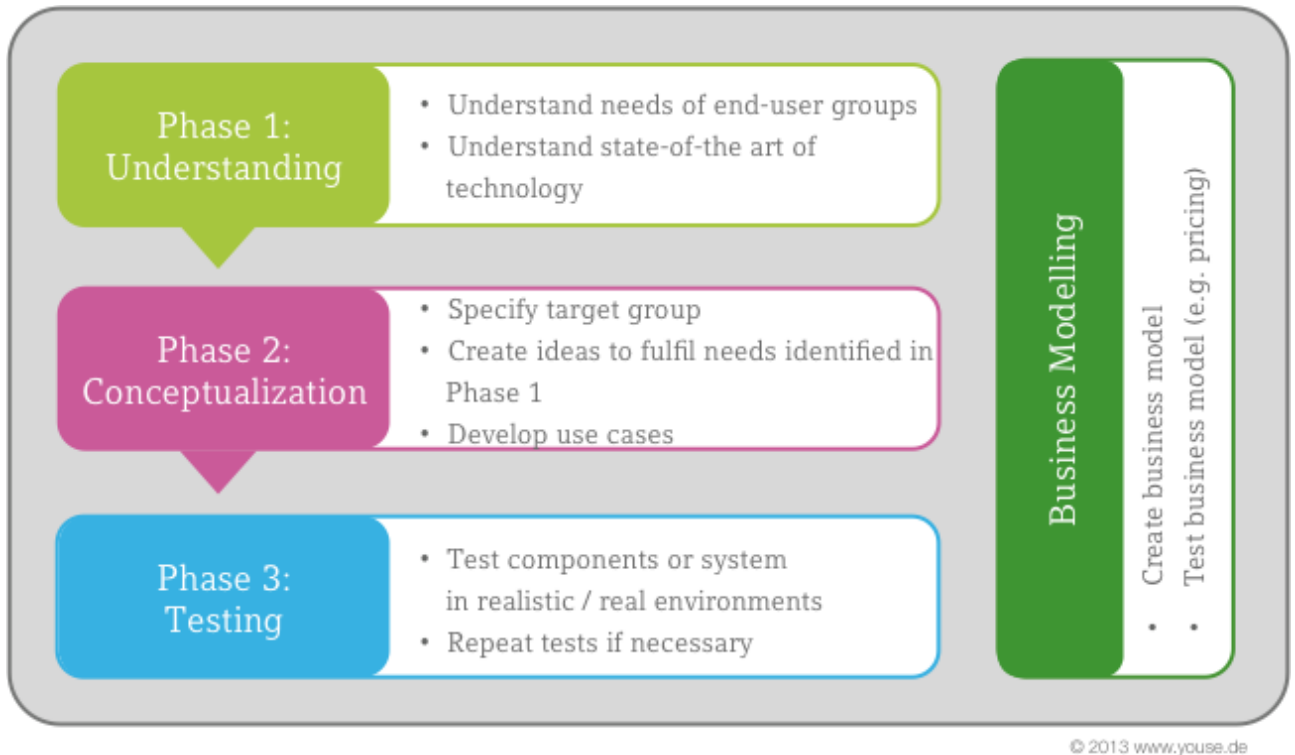


Figure 1: Basic model of ICT development for AAL projects focusing on the integration of the users' perspective throughout the technology development and realisation.

1.2.1 Understanding

It is necessary to create an **understanding** of the potential users and their routines in relation to the general development goal in the first phase. Without a good understanding, the solutions might be brilliant in technical terms, but useless from a user point of view. The user-centred product's foundation is therefore laid in this first phase. This phase should be strongly emphasised in order to build on real data instead of stereotypes.

It is essential to collect data on the users during this first phase: What are their habits, their fears, their wishes, their problems? The overall aim is to answer questions such as: For whom do we design and what value does our solution add for the target group? These questions are closely related to business modelling (see Section 1.2.4). The future context of AAL's use should also be evaluated during this phase: Who are the stakeholders who influence the user? What are the daily routines into which the AAL solution has to fit? Which solutions - perhaps unknown to the users - are available to fulfil their needs? Rather than thinking about new solutions that might face the same problems as existing ones, you could look into improving these solutions and offering a better alternative.

Finally, it is also necessary to be aware of the technological state of the art, i.e. to ask: What is technologically and financially feasible?

The understanding phase should predominantly involve qualitative methods, such as literature reviews, interviews, market research, and ethnographic observation techniques (like > **Shadowing**, > **Contextual inquiry**, > **Self-documentation**).

1.2.2 Conceptualisation

The conceptualisation phase is concerned with developing and specifying use cases based on the user needs identified in Phase 1. As in all phases, this one comprises various levels, including the general idea behind the solution's functionality and the conceptualisation of the user interaction.

This second phase is really the creative phase. It should involve imagining and thinking through the solutions – determined in Phase 1 – that fulfil users' needs, that apply the latest technology, and that remain within budget.

Creativity methods, such as the > **Walt Disney method**, > **Brainwriting** and > **Story-boards** are typical methods for developing and visualising concepts.

1.2.3 Testing

In the last phase of the user-centred design process, single components, prototypes, and the complete solution are tested for their usability (smooth use) and user experience (emotional aspects of the use). Although this is a later phase in the innovation process, user testing can occur iteratively throughout the innovation process: smaller aspects of the final solutions, like the interfaces, aesthetics, and components, can be tested separately in the early stages to integrate the results into the technical development. We encourage projects to start testing components early on in order to avoid wasting too many resources on developing final solutions that don't meet users' needs.

Testing can be done in realistic, but controlled environments (e.g. certain tasks in laboratories), as well as in real environments (e.g. long-term field trials in users' homes). The choice of either environment depends on the resources available and the goal of the test: While the early development stages of a solution should be tested in controlled environments, the analysis of the system's suitability for daily use, or of its impact on the system's well-being over a longer period of time obviously requires real environments.

Typical methods for checking prototypes in their early development stages are > **Paper prototypes** and > **Wizard of Oz**. Other methods, such as standardised questionnaires (e.g. WHO5 for well-being, or the PSQI for sleep quality) and interviews can also be applied to evaluate, for example, health improvements due to AAL solutions.

1.2.4 Business Modelling

Although **business modelling** is not a separate phase of the user-centred design process, we want to point out important aspects regarding making the business model user-friendly.

Generally speaking, business modelling should be part of the user-centred design process from the start, because any solution developed as an AAL project should always be affordable. Therefore, when creating a business model, you should integrate the users' and stakeholders' needs and wishes. For example, try to determine who will pay for a solution, who will buy a solution, who will decide to buy a solution, what kind of communication is relevant with these people, what are their price sensitivities and how can you market a solution.

The methods used to answer these questions do not differ fundamentally from those used in the other phases. These questions should therefore be evaluated together with other relevant aspects in the other process phases. For example, if, during the conceptualisation phase, you ask users in a focus group which solutions they prefer, it is important to also ask them what they are willing to pay for them.

Consequently, this document does not specify particular methods for business modelling. For more information on business models and AAL stakeholders, you can refer to the toolkits for business models that are suitable for AAL projects (D4.2), which have been developed in conjunction with the European Innovation Partnership on Active and Healthy Ageing (EIPonAHA)³.

2 ABOUT USER INTEGRATION

User integration refers to the art and science of learning about users' wishes, desires, cognition patterns, problems with existing solutions, finding business models and much more in order to develop a successful product. Does this sound confusing?

The reason for this might be the countless possibilities and benefits that user integration into a product development process offers – from understanding user needs (e.g. user studies), and including users in the development of ideas and concepts (e.g. open innovation and ideation (idea generation) as well as the testing of products (e.g. user testing) to developing business model concepts together with potential clients (e.g. market research). **Figure 2** shows that user integration encompasses many aspects, and is itself a tool that can be used in the user-centred design process together with methods like people or heuristics, which are briefly discussed in Chapter 4.

The following chapters describe how the art and fun of user integration can be managed efficiently and effectively. We start by looking into the benefits and limitations of user integration. Once we have convinced you of the potentials of user integration, we concentrate on the issues you should consider when planning user integration in your AAL project, such as the recruitment of users, providing users with incentives to help you and, of course, the ethical aspects of user integration. We subsequently describe a number of user integration methods that can be used in the different phases of the innovation process. These methods were selected because they are easy to use and provide good results with comparably little effort.

³ http://ec.europa.eu/research/innovation-union/pdf/active-healthy-ageing/a2_action_plan.pdf

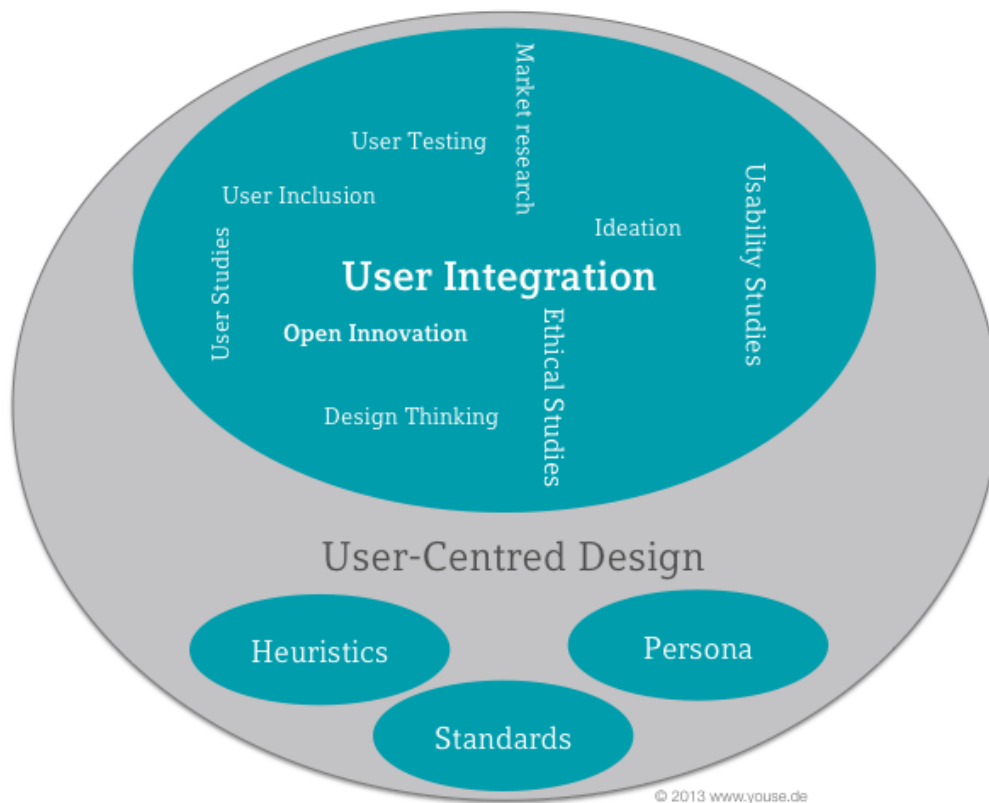


Figure 2: Overview of user-centred design and user integration.

2.1 BENEFITS OF USER INTEGRATION

Determining actual user needs instead of merely guessing or generalising can make the difference between a real innovation for users or simply an interesting technical development for the shelf. Using appropriate methodologies to integrate users throughout the innovation process is a very effective way to determine their wants and needs, but also to learn about their fears and worries. In short, user integration can help improve a product from a user perspective.

‘Supposing is good, but finding out is better!’ *Mark Twain*

As Jeff Besoz, the founder and CEO of Amazon, clearly pointed out in his 1997 letter to Amazon’s shareholders, a focus on customer needs is the key to success: ‘We will continue to focus relentlessly on our customers’. Their focus on user needs during the product development process leads to superior products that are often more successful than those of their competitors. At the same time, user-friendliness increases customer loyalty (see GfK, 2012). The most important benefit of user integration is probably that it allows a user-friendly product to be created. User-friendliness involves the overall user experience - from the users’ expectations of a product, its ease of use and practicability (usability) to the joy derived from it (see **Figure 3**).

Integrating users early on in the innovation phases will most likely increase the final product’s user-friendliness, but also save companies a lot of money during the development process as mistakes can be avoided early on. **Figure 4** illustrates how costs increase if errors have to be corrected in later the innovation phases – although most errors occur in the earlier phases.



Figure 3: The difference between usability and user experience according to DIN ISO 9241.

This information is especially relevant for AAL as many of its innovations compensate for age-related weaknesses, thus addressing elderly people’s sensitivities. User acceptance is therefore especially critical. Considering people’s true needs during the innovation phases, while excluding unwanted aspects, will improve their acceptance. However, if these needs are included too late in the innovation process, the costs of finding and integrating solutions into the almost finished product will increase considerably and, at some point, become too expensive. Examples are using integration to safeguard against data abuse, or defining ownership models for the collected personal data.

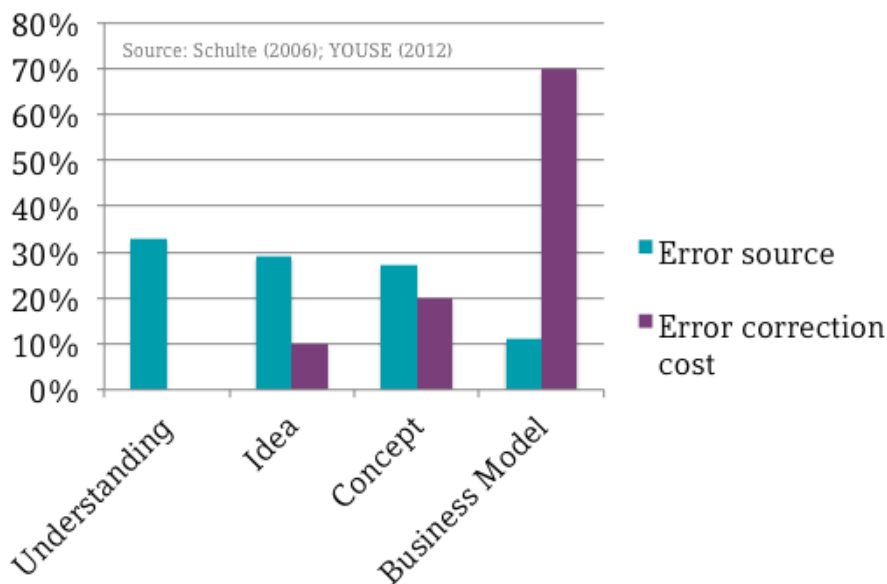


Figure 4: Error sources and the cost of error corrections in innovation.

In addition to the costs of user integration (in terms of time and resources), each phase has many benefits, which will be illustrated in the following sections: from understanding the users (Phase 1), to conceptualising an idea (Phase 2), testing the product (Phase 3), and developing business models.

2.1.1 Benefits of User Integration in Phase 1: Understanding the User

It is essential to establish what users want during the early phases of the innovation process. Without understanding what needs and wishes a product is supposed to satisfy – or which errors to avoid – the success of product development will be left to chance.

Thus, integrating users in Phase 1 helps us understand users' behaviours and 'which' solutions are needed. User integration can simply mean observing users in their daily routines or under special circumstances. However, more elaborate forms may be used, for instance asking users about their needs and the ways in which they struggle to fulfil them with the available solutions.

Key benefits of understanding:

- avoid misunderstandings regarding users' needs
- avoid incorrect generalisations
- identify real user needs
- understand real problems
- identify market potentials
- save on costs by avoiding blind alleys in the product development
- understand ethical issues

Although many innovations originate from engineers, businesspersons, or anyone who has experienced an unfulfilled need, generalisations about older adults based on one's own needs or assumptions must be avoided at all costs. It is best to verify a statement like 'I know my grandmother very well and she would never use such a product' by comparing it with more empirical data. People differ; some are more open to and interested in using new solutions than

others, some prefer sticking to what they know. Similarly, seniors might regard a product that a product developer thought the older target group would love as absolutely useless (e.g. refrigerators that order groceries automatically when supply levels are low). Therefore, integrating users in an early phase and understanding their wishes and fears will allow innovators to avoid mistakes early in the product development process and, consequently, save them a lot of time and money.

In the end it boils down to a simple truth: Data trumps opinion. However be aware that asking users about their wishes is not a straightforward task for two simple reasons: Users often do not know exactly what they want, or how to express their need, and are sometimes unwilling to say what they really want due to, for instance, social biases.

It is up to the innovator to ask the right people the right questions, to gain a valid understanding of the user needs (see Chapter 3.2).

2.1.2 Benefits of User Integration in Phase 2: Conceptualising

It may be very beneficial to integrate users in the second innovation phase, when ideas for a new product are formed. First and foremost, users might just have a great idea of what the product should be, or what a solution should look like and how it should function. Just think of a product you use that frustrates you. How often have you thought: ‘Why is this product so difficult to use? They should have asked me, I would have told them

right away that this button doesn’t make sense... that the label is misleading...’ The same applies to products for older people. They are the best experts of their daily routines, of what they like, and what they don’t like. Involving users and listening to them – instead of researchers and technicians making important decisions – will ensure that fewer Ambient Assisted Living (AAL) users have a frustrating product experience. It may also help create joy of use if the solutions benefit the user and are easy to use. User integration during this phase may provide valuable insights into the ways in which customers want to solve a problem from a functionality point of view. After all, a good product should be as intuitive to use as possible, which will also help save on customer care costs (e.g. as fewer customers will require instructions).

Key benefits of conceptualising:

- Utilise users’ creative potential
- Consider users’ experiences when developing problem-solving tactics
- Allow users, engineers and stakeholders to cooperate in solution development

However, to ensure successful user integration - especially in this phase - it is important to realise that not all users will be able to provide ideas to solve a problem and not all their ideas will be valid. Therefore, we suggest working with what we call ‘lead users’ in this phase. Lead users have a

strong drive to improve their current situation and often already have ideas for solving a particular need – usually in an unconventional way. They are the ones who approach family members and friends when they need assistance in a specific field, for example, when they need their computer repaired. Since they have sufficient ICT/technology experience, they have no trouble using it and are thus free to explore potential new services. However, lead users’ ideas should be applicable to other users’ actual needs as determined during Phase 1 – after all, a lead user in one field, say in mobility innovations, is not necessarily a lead user in care-giving innovations.

2.1.3 Benefits of User Integration into Phase 3: Testing

The goal of the third phase is to make the product fool proof by testing it or its parts. Remember, the whole process is iterative. After Phase 3, you might need to revisit Phase 2 or even 1. The variety of methods used for testing is a strong influencing factor. The benefits of asking users from the target group to test a product, instead of the development team or random people (e.g. a spouse), should be quite obvious: Real users’ usage behaviour and experience usually differ significantly from those of the development team’s experts.

Key benefits of testing:

- Make sure that the innovation works without mistakes
- Make sure that the innovation’s usability for the target group is as high as possible

In this testing phase, users can help innovators detect real errors in the developed product or prototype, such as dead-ends or loops in a software application. Users can furthermore detect misunderstandings in the product or interface’s design that deter usability, such as misleading labels, misplaced buttons, or menu structures that are difficult to understand. Finally, user testing may lead to surprising discoveries, such as the unexpected ways in which a product can be (mis)used. This may lead to problems in a good case scenario, or may be dangerous in a worst-case scenario.

Conducting product tests can take various forms – from laboratory to field tests, from small-scale user tests to grand scale medical tests. The type of test will depend on the goal behind it, as well as on the available resources. Whatever the case, innovators should be prepared to put more work into the innovation after the test. They should not feel that their creativity is being challenged if testers find flaws in the product as it is.

2.1.4 Benefits of User Integration into Business Modelling

Many articles have discussed the advantages of incorporating user integration into the first three phases of the innovation process and this has been proven to benefit the innovator. The integration of

Key benefits of business modelling:

- Understand the buying process of decision makers and those who pay for the product (not necessarily end-users)
- Develop a marketing strategy that works with the targeted users

users in order to develop sound business models has not yet received the same level of attention.

Integrating users (primary, secondary and tertiary) can be very beneficial for the innovator, not only in terms of identifying the decision maker who may or may not be the one paying for the solution, but also in finding the right language and ideas for marketing. It may be tricky to determine who pays for AAL solutions, as insurances, municipalities, enterprises, seniors, or their relatives, or other benefactors may be responsible for payment. Nevertheless, it is important to identify and understand the potential paying party as well as the person making the buying decision in order to design the buying and decision process with maximum ease and benefits for all groups.

Integrating different types of users into this phase, allows innovators to determine the most effective way of selling their product (e.g. what are insurance brokers' requirements for paying for a product?) and the best way to communicate with different users and stakeholders. And although this phase seems to only be important at the end of the innovation process, we urge you to consider the business model as early as possible, especially if one considers that insurance companies demand certain functionalities in a product in order to pay for it. No innovator wants to start from scratch just because an important feature was excluded, making the product unsalable.

While the goals of user integration for developing a user-friendly product obviously differ from those of developing a business model, the same methods can be used to integrate the different users: The methods for understanding, conceptualising and testing can be applied to this phase as well (e.g. focus groups or expert interviews).

2.2 LIMITATIONS OF USER INTEGRATION

Despite having many advantages, there are limitations to integrating users into the innovation process. Firstly, user integration is a resource-intensive exercise. As a qualitative discipline, user integration often requires considerable time because it involves recruiting the right user group and conducting workshops or tests to analyse and evaluate the results.

Integrating users can be very costly: It might be necessary to hire professionals to recruit users or to help conduct workshops or tests. Professionals may also be required to perform market analyses through observation to determine aspects that the technical experts cannot cover in a research consortium, or simply because information on a specific market, to which the consortium has no access, is needed.

Main limitations of user integration:

- Risk of listening to the wrong ideas and developing the wrong product
- High cost of integrating users
- High time resource needs for user studies
- Difficulty with recruiting the right users
- Lack of knowledge regarding the best user integration methods
- Risk of violating ethical considerations

It can also be very difficult to find the right users (e.g. lead users in a certain area) or to convince them to share their experiences and ideas in a workshop (see Chapter 3.2. for ideas on overcoming these hurdles). Once this has been achieved, the next hurdle is selecting the right method to integrate users, as the wrong method can lead to wrong results. Take, for example, testing the graphical interface of a social network for seniors: Providing inexperienced seniors with a tablet computer with which to test the application at home will most certainly frustrate them and lead to insufficient usable results. In such a case, a supervised laboratory test will be more beneficial as users can be ‘taken by the hand’ and don’t have to experiment on their own.

Another limitation of user integration is that the results of a user study are rarely unanimous, making them difficult to analyse. Take, for example, a creative workshop during which many ideas for a new walker are discussed: Which one is the best and worth pursuing? Should you make this a democratic exercise and allow your focus group to decide? However, the results of the user integration are incomplete and the bright idea that you hoped would appear is still missing. Nevertheless, conducting one user study after another will not always bring clarity and might even add to the confusion.

The final limitation of user integration is the biases that you might encounter in user feedback. Owing to people’s socialisation within groups, the lacking connection between people’s conscious and sub-conscious, and to group pressure being exerted, users do not always know, or are not always able to express what they want. Many studies have shown that we are all, to a certain degree, prone to bias:

- Confirmation bias: a reluctance to search for or accept information that contradicts existing beliefs.
- Frame dependence: the same pattern of explanation is applied, even when the circumstances differ.
- Anchor bias: placing a lot of importance on one’s initial perception and struggling to break away from that perception.
- Hindsight bias: the inclination to see past events (often against evidence) as a predictor of the future.
- Herd behaviour: basing decisions on those of others due to the fear of being the only one to make a mistake.
- Consensus bias: agreeing with the rest of the group because disapproving is more challenging than maintaining a ‘positive atmosphere’.

These biases can produce incorrect information. The motives behind our experience and behaviour are only seldom obvious. For instance, users’ feedback might suggest that a control element could not be found because it was too small, but the truth is that there were too many distracting elements.

In these situations, the consortium has to make an informed decision about which ideas to pursue and develop further, or how to solve usability problems. Both the users’ wishes and the

consortium's market/technical knowledge (and creativity) have to be considered, for example, by using > **Selection lists**. After all, even with user integration, there will still be uncertainty regarding a product's or market's future and pursuing inventions will always be a risky endeavour (otherwise it would be a no-brainer).

3 USER INTEGRATION IN PRACTICE

The following pages discuss user integration methods in AAL projects. We start by giving a short overview of possible sources of user integration methods in the many scientific fields in which it occurs. The document then explains what to consider when designing a study in conjunction with users. Finally, we describe the user integration methods.

3.1 SOURCES OF METHODS

User integration has many facets and many names and there are many methods of integrating users into an innovation process (see **Figure 5**). Therefore, it is not surprising that users are often asked to test or evaluate solutions. Partly due to legal obligations, medical sciences are one of the forerunners of user integration in the test phases. The pharmaceutical industry is a close second, as users are required to test medicines and treatments' effectiveness, often as part of clinical studies. User integration also plays an important role in marketing, where, for example, price sensitivities are evaluated using conjoint analyses (a statistical technique) – in laboratories and in the real environment. In ergonomics (the study of people's efficiency in their working environment), users are asked to test products' ease of use and the comfort with which they can be used. Similarly, in design and IT (e.g. software design), users are asked to test a product's usability and, increasingly, the individual user experience (e.g. with a methodology from software development called 'Scrum' that develops software iteratively and is hence more agile). Obviously, the study of human behaviour is central in ethnographic studies and psychology, and these fields have developed a host of methods for studying emotions, needs, wants and fears – even those of which the user is unaware. In innovation sciences, users have a greater responsibility, because they have assumed the role of innovators, while, in many other sciences, they merely test the solutions. Similarly, in service design, users are increasingly integrated into the earlier innovation phases, for example, as part of a design thinking process or 'ideation'(idea generation).

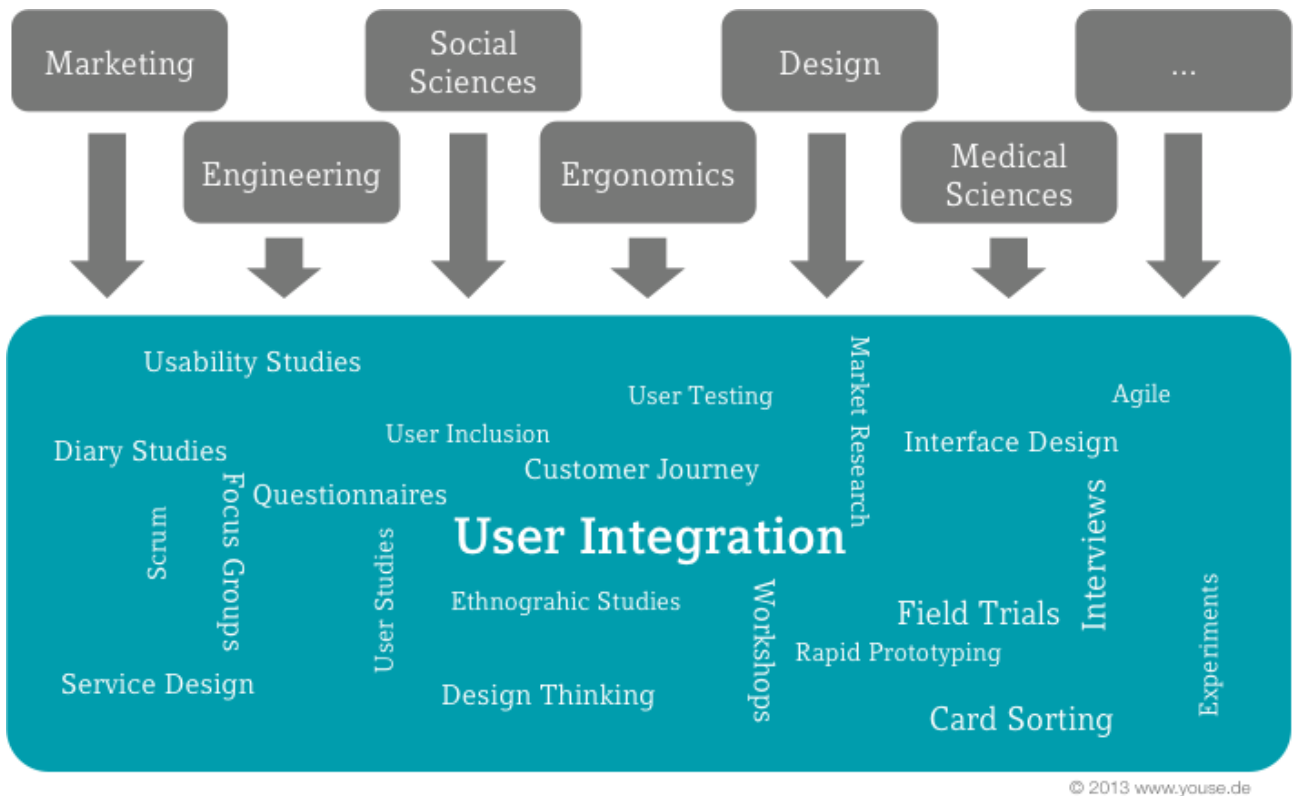


Figure 5: Sources and methods of user integration.

Clearly, this document cannot explain the user integration methods of all of these sciences, as each has particulars that are beyond the scope of this guideline. Nevertheless, as a practical guidebook for user integration, this document needs to be transdisciplinary and will describe some methods from various sciences in lay language to allow a broad range of experts, who want to include users in their innovation process, to do so.

3.2 BEFORE YOU START:

SEVEN ISSUES TO CONSIDER

Although user integration seems rather straightforward – ‘just ask the users’ – it requires time, resources and some experience. Using the wrong methods might not only frustrate the users and the researcher, but might also lead to the wrong results. Coca-Cola probably made the most expensive mistake in user testing history when the company gave users a sip of the product in the laboratory to test its ‘New Coke’ in 1985. It was rolled out throughout the US and the old coke was discontinued. However, sales dropped and the ‘Classic Coke’ had to be reintroduced at very high costs only half a year later. What went wrong? A sip or two, or even a glass of the ‘New Coke’ in the laboratory was to the customers’ liking, but having a whole bottle of the drink in front of the TV or for dinner was a different story.

You should therefore plan your user integration process thoroughly. The following pages describe the steps you need to take (see **Figure 6**). At some point, it might also be worth getting professional help. It may be expensive, but if one considers the cost of innovating the wrong product, it might just be worth it!

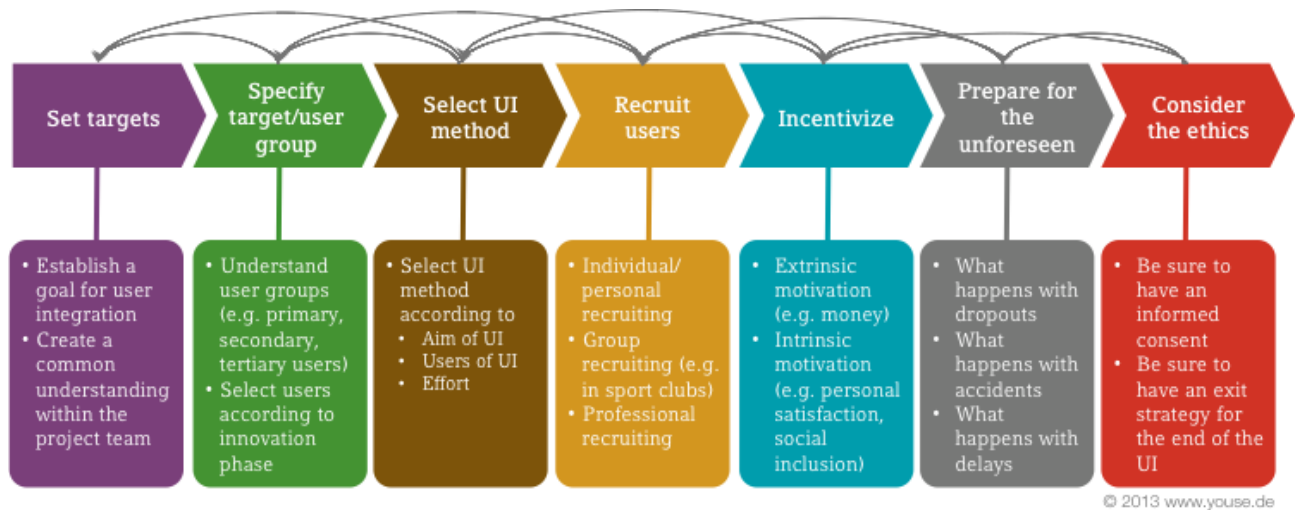


Figure 6: Seven issues to consider before integrating users.

3.2.1 Set Targets and Create a Common Team Understanding

The first step in ensuring successful user integration in AAL projects involving various experts (e.g. IT, hardware and sociology), is to create a common understanding of their targets. This step has two stages.

- Establish a **goal** for user integration. Ask yourself: Why do you want to integrate users? In other words, specify the questions you want to find an answer for by integrating users.

- Create a **common understanding** among the interdisciplinary project team members whose ‘dialects’ may differ (e.g. the word ‘service’ means something completely different to a care professional than to an ICT developer).
In other words, ensure that everyone involved in the development of user integration and in the results of the user integration have the same viewpoints.

These steps cannot be achieved on their own but need to be taken with others. Creating a goal for user integration depends on the problem that needs to be solved. The question of how a house-cleaning device can be designed to help older people remain independent is very different from the question of how a room can be kept clean. Therefore, take your time to explain the research questions to be answered by means of user integration within the consortium. During these discussions, it usually becomes apparent that the ‘dialects’ of the different disciplines in a research consortium do not necessarily match. A common language needs to be established (or defined) to ensure a common understanding among team members (e.g. with regard to how the experiments should be designed, the hypotheses’ formulation, the level of expertise expected from one another, etc.). Once there is common understanding, a team can work together to achieve a certain goal.

3.2.2 Specify a Target and User Group

The next step in planning user integration is to specify which user group(s) should be included. The AAL Association distinguishes between primary, secondary and tertiary users (see the > **Knowledge Base** for details):⁴

1. **Primary end-users** are individuals who use an AAL product or service – the well-being persons. This group benefits directly from AAL through their increased quality of life.
2. **Secondary end-users** are people or organisations in direct contact with primary end-users: formal and informal carers, family members, friends, neighbours, and care organisations and their representatives. This group benefits directly from AAL products or services when they use these (at a primary end-user’s home or remotely), and indirectly when primary end-users’ needs for care are reduced.
3. **Tertiary end-users** are institutions and private or public organisations that are not directly in contact with AAL products and services, but who somehow contribute by organising, paying for, or enabling them. This group includes public sector service organisers, social security systems and insurance companies. They benefit from the increased efficiency and effectiveness that AAL solutions provide in terms of reducing costs, or avoiding increasing costs in the mid and long term.

Be aware that the integrated users are not necessarily the target group (i.e. primary end-users) to whom this product is marketed! Sometimes, researchers can learn more about the requirements that AAL solutions need to fulfil from secondary or tertiary users. For example, if a system aims at

⁴ <http://www.aal-europe.eu/get-involved/i-am-a-user-2/>

supporting demented seniors, who are difficult to interview directly, it is better to address relatives (secondary users) or insurance companies (tertiary users) to learn about primary users' needs or routines. On the other hand, many different user groups can potentially be included. Decide which methods are suitable for user integration (see method descriptions) and make sure the design guidelines specified in the > **Knowledge Base** (Chapters 2 & 3) are followed.

However, not all users in a specific user group are suitable to participate in all innovation phases. The work package leader should set clear criteria for the selection of users. The following pointers may help in this regard:

- In the **understanding phase**, you can work with group averages to understand users' typical behaviours, needs, wishes and fears. You can focus on extreme users (e.g. people with severe restrictions or disabilities) to get a full picture of users' potential problems (e.g. during the course of deteriorating health).
- In the **conceptualising phase**, the average users might not be willing to change their habits in favour of a more advanced solution – simply because they are not properly informed about it. Consequently, the average user is not the best person to produce new ideas to solve a problem. It is therefore better to integrate lead users, who are forerunners in a certain field and have specific qualities, such as seeking new solutions and being open to new ideas. They can draw on their rich experience to create new ideas to overcome problems they face in their area of expertise (e.g. taking care of patients with dementia).
- In the **testing phase**, average users as well as rather sceptical or novice users, who are more likely to voice their criticism and their usability problems, may be integrated. Don't be disheartened if these users disagree with many of your ideas and concepts – take their criticism with a grain of salt, but also use it as a guidepost to address errors and sources of frustration. Keep these issues in mind when communicating with this user group in future and when marketing the product.
- In the **business model phase**, we suggest integrating users representing the target group, namely decision makers and those parties that pay for the solution. This is not necessarily the user group, but persons who are likely to buy the product or make the decision about a purchase. This group may comprise a variety of stakeholders: relatives, caregivers, institutions, insurance companies, and, of course, users. Make sure you only include people who are likely to buy the product and not just those who might have good ideas. After all, if you want to sell something (say on the secondary health market, i.e. without insurers' financial support), it makes more sense to develop business models with the people who can afford this product (and are in need of it) than with someone who only needs the product.

In general, it is crucial to select the right users for a particular innovation phase and user integration goal. This can also mean that it makes sense to sometimes select younger users than the one of your target group, as the target group itself might be not the target group any more once the product development is finished – simply due to time reasons.

In addition, it can be useful to use the same participants for different phases; dealing with the same topic over time may make their input more valuable (e.g. conducting a workshop for idea creation with users you have used for self-documentation in the analysis phase). However, in some cases, it is better to integrate different users, especially if former negative experiences might bias a system's evaluation (e.g. if users have collected ideas for an AAL solution that could not be implemented in a prototype). Moreover, users who tested interfaces' usability should not be used in later field trials with the improved system due to their anchoring biases.

In regard to the type of users, we emphasize that this guideline should not be considered as a binding document, but rather as giving ideas to which users to integrate. In the end, it depends on the specific problem at hand which users to best integrate.

3.2.3 Select A User Integration Method

Once you have defined whom to integrate and what to analyse, you should determine the most efficient and economic method to achieve your goal. This guideline and the toolbox will assist you with choosing the right methods for each research question and innovation phase (see **Figure 7**):

1. What is the **aim**? (> Corresponding to the developmental phase)
 - a. Understanding the user
 - b. Conceptualising a solution
 - c. Testing a solution

2. Who do you want to **integrate**?
 - a. Healthy seniors
 - b. Impaired seniors
 - c. Stakeholders
 - d. A consortium

3. How much **effort** are you willing to or can you invest in terms of time and resources?

Once you have considered these questions, it becomes quite easy to select a method to help you solve the problem at hand. You find more detailed information about each method in Chapter 3.3.

Phase	Method	Participants				Effort
		Healthy Seniors	Impaired Seniors	Stakeholders	Consortium	Time & Resources
Understanding	Persona	+	+	+	+	++
	Self-documentation	+		+		++
	Shadowing	+	+	+		+++
	UTE-Analysis	+		+	+	+
Conceptualization	Walk-Disney-Method	+		+	+	+
	Brainwriting	+		+	+	+
	Storyboard				+	++
	Selection-List				+	+
Testing	Cognitive Walkthrough	+		+	+	++
	Paper Prototyping	+		+		+++
	Wizard-of-Oz	+	+	+		+++
	Co-Discovery	+	+	+		++

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Figure 7: Classification of user integration methods from the AALA toolbox.

3.2.4 Recruit Users

After selecting an appropriate method to tackle the question at hand, you are ready to recruit users if you haven't done so already. Recruiting the right users is one of the most important determinants of successful user integration. Once you have selected a user integration method and a user group, it should be fairly easy to determine the type and number of users you need. However, unless you have direct contact with them, the question of where to find them still remains. It is challenging to recruit users who have never participated in an experiment or social research project. However, there are several strategies for contacting and motivating people to participate in a test. Common recruitment strategies for new users are:

- Posting newspaper, radio, or local TV ads
- Advertising (e.g. flyers and posters) in public spaces
- Placing internet ads (e.g. on social networks or relevant webpages)
- Recruiting them personally in public spaces
- Visiting intermediaries (e.g. senior clubs and sport clubs)

You could also use professional recruiting services (e.g. for market and social research). And, finally, your personal contacts might come in handy.

It is important to be aware of the costs and time required to recruit appropriate users. It is wise to start recruiting as early as possible as – contrary to some people’s assumptions – older people, and especially older people who can help with innovations, often have a very busy schedule.

3.2.5 Incentivise Users

Users need a reason to participate in an innovation or research project – an incentive. The right incentive might not only attract user participation, but also ensure good results and – especially in the case of longer field trials – keep participants motivated.

There are two types of incentives that may motivate people to participate in an innovation project:

- **Extrinsic motivation:** material or financial reimbursement (e.g. money, equipment, health checks, health consultation, etc.)
- **Intrinsic motivation:** personal interest and satisfaction (e.g. opportunities to expand personal experience and knowledge, social recognition, meeting new people, etc.)

There is no one right incentive. Incentives’ effectiveness will strongly depend on the context, the user, or the task at hand. However, we recommend using the same incentive for all users within one round of user integration. When offering an incentive, be aware of the consequences: If you give too little, users might not participate the next time, or won’t give their best; if you give too much, you will set higher expectations for the next time you need users. And be aware that although money can be a great incentive, some seniors will value the appreciation behind the incentive more (e.g. a 10-Euro ticket for a joint visit to a museum may be worth more to them than a 10 Euro note).

It is important to continuously offer incentives to users in longer term field trials. It is usually not enough to compensate them at the end of, say, a 6-month trial period. We recommend giving them a little something on a regular basis.

3.2.6 Prepare for the Unforeseen

Now that you have established the goal, selected the method and recruited the users, it is time to prepare for unforeseen events before starting the process. This means you have to consider the when, the where, the process, the contingencies, the recording of results, etc. Whereas the when and the where and, perhaps, the process may seem straightforward, you should keep a close eye on the contingencies – which is rather like managing risks. You should consider questions such as:

- What should we do if a user or several users drop out (or don’t show up)?
- What happens if the product to be tested doesn’t work?
- What happens if the research project has delays (e.g. which is a relevant question regarding field trials)?
- What happens in case of accidents?

Make sure that you capture the relevant information when recording the results. The challenge is often to record enough, but not too much – not only for ethical reasons (see the next chapter), but also because of the work involved in evaluating the data. It is a waste of time and effort if the data is irrelevant to the question at hand. Therefore, check that what you record is relevant for the target you have set.

3.2.7 Consider the Ethics

In order to integrate users into an innovation process, it is important to answer ethical questions and design the user integration process accordingly.

It is very important that users are fully informed about the goals of the study and the type of data being recorded. They should participate with the full knowledge of what they will be doing and why, also called informed consent. Users should also be allowed to leave the study at any time.

When recording data, the consortium needs to consider the anonymisation or pseudonymisation⁵ of recorded data and must inform the users about the level of data protection.

An important ethical consideration is the exit strategy at the end of and after the user integration. The user integration work package should ensure that users don't feel abandoned or lost after the user study due to the withdrawal of attention, technology, etc. The transition should be made as comfortable as possible, for example, by giving them the option to keep (or buy) a product or service, or to stay active in a group of other testers.

Be aware that an ethics commission needs to approve most types of user integration, for example in medical field trials, or when private data is gathered. Ethics commissions are often accessible through universities.

3.3 DESCRIPTION OF USER INTEGRATION METHODS

There are very many methods for integrating users into an innovation process. The following figures provide a summary of these methods according the three phases of the user-centred design: understanding, conceptualisation and testing (the methods in bold are described in more detail in the following chapters).

⁵ Pseudonymisation means that a participant's data is disguised, but in a way that allows the linkage with additional data (e.g. by key-codes).

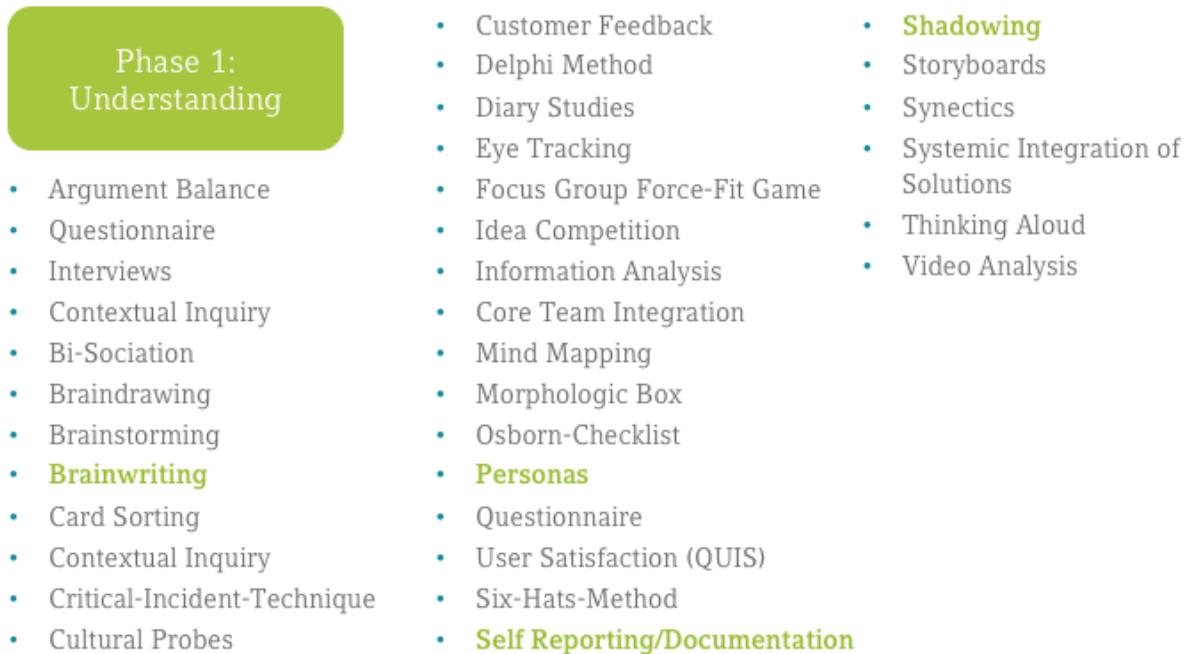


Figure 8: Methods for User-Centred Design in Phase 1 - Understanding

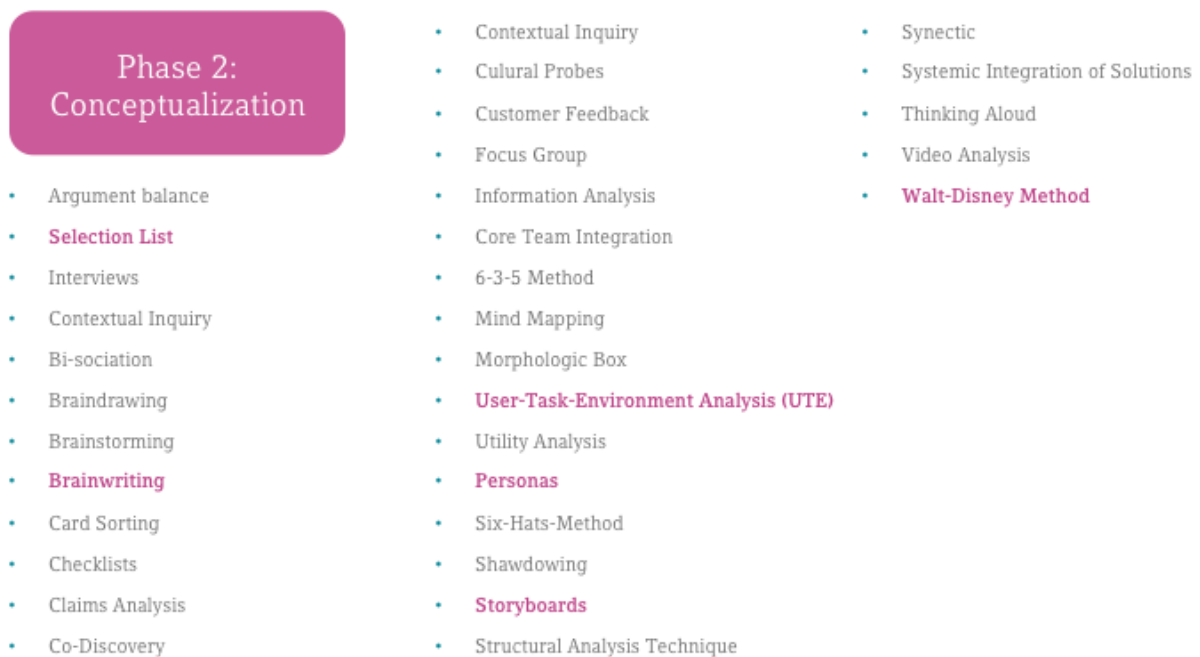


Figure 9: Methods for User-Centred Design in Phase 2 - Conceptualisation

Phase 3: Testing

- AttrakDiff
- Contextual Inquiry
- Checklists
- Co-Discovery
- **Cognitive Walkthrough**
- Critical-Incident-Technique
- Diary Studies
- Simple Point Scale
- Eye Tracking
- Field Test
- Five-Second Test
- Focus Group
- Geneva Emotion Wheel (GEW)
- Information Analysis
- ISO Metrics S/L
- ISO Norm 10/110
- Isonorm Questionnaire ISO9241
- Core Team Integration
- Multiple User Simultaneous Testing (MUST)
- Mystery-Shopping
- **User-Task-Environment Analysis (UTE)**
- Out-of-the-Box Test
- **Paper Prototyping**
- Physiological Measurements
- **Personas**
- Questionnaire of User Satisfaction (QUIS)
- Rapid Prototyping
- Remote-Usability-Test
- Six-Hats-Method
- Self Assessment Manikin (SAM)
- Self reporting/documentation
- **Shadowing**
- Software Usability Measurement Inventory (SUMI)
- Sociotechnical Walkthrough
- **Storyboards**
- Structural Analysis Technique
- Synectic
- Systemic Integration of Solutions
- Systems Usability Scale
- Technical Stress Measurement
- Thinking Aloud
- User Experience Questionnaire (UEQ)
- User Experience Test
- Video Analysis
- **Walt-Disney Method**
- Web Usability Index
- **Wizard of Oz**

Figure 10: Methods for User-Centred Design in Phase 3 - Testing

Please note that we only describe a few of the many methods to create user-friendly products. The methods stem from various disciplines, such as ergonomics, innovation research, psychology and ethnographic studies (see Chapter 2). Many more methods are available and you can develop new ones, especially in the creative phase. However, please be aware that standardised tests (see Chapter 4.2), such as the WHO5, the Geriatric Depression Scale for well-being, and the Pittsburgh Sleep Quality Index can only be adapted very cautiously – if at all – in order for them to remain valid.

The following pages describe 11 methods for user integration from that overview that were selected regarding the following criteria:

- Can the methods help gather data that are important in typical AAL projects?
- Can the methods be used with seniors with and without impairments as users?
- Can the methods be used even without extensive expertise regarding user-centered design?
- Do the methods cover the relevant fields to take the interdisciplinary character of project consortiums into account?

Although the list is far from complete, these 11 methods should help AAL project managers with their user integration efforts, as they are easy to use and deliver good results in terms of user insights. We discuss these methods alphabetically because some can be used in various phases.

3.3.1 Brainwriting

Brainwriting (sometimes referred to as the ‘Gallery method’) is a creativity technique with which end-users or other stakeholders generate many concrete ideas for product functions or services.

Example: Generate functions for a service robot to enhance elderly users’ independence.

Why use it?

- Develop ideas quickly
- Evolve ideas quickly by means of user inputs
- Allow ideas to be discussed easily as everybody sees everybody else’s ideas

When to use it?

- Conceptualisation
- Business model

How to use it?

1. The workshop supervisor presents the problem/task.
2. Each participant receives a form and a pen
3. On the form, the participants write down 3 suggestions for solving the problem, but have to respect the time limit (e.g. 3 minutes; the first round may take longer)
4. The form is passed on to the person sitting on the left of a participant.
5. Each participant refines or amends the suggested ideas (3-6 min.)
6. Repeat Steps 4 and 5 until everyone has his/her original form back.
7. If the proposed ideas cannot be refined, the form is placed in the centre of the table (‘pool’), and, if available, another one is handed out.
8. The solutions are presented and discussed.

When not to use it?

- When you want to understand user needs
- When you want to discuss already developed ideas
- When the group is too small (fewer than 4 people)

Special hints

- Take your time to explain the method to the participants
- Don’t suggest too many solutions, as you might bias the users who have to suggest them
- Don’t judge ideas too early
- Set aside some time to discuss and evolve the ideas at the end

Further reading McFadzean, E. S. (1997). Improving Group Productivity with Group Support Systems and Creative Problem Solving

Techniques. Creativity and Innovation Management, 6 (4), 218-225.

3.3.2 Co-Discovery

Co-discovery is a usability test involving two participants, which makes the feedback more natural and lively than tests with just one participant and the ‘thinking aloud’ method. Participant test the usability of a product or prototype in pairs and describe what they think about this.

Example:	You want to test the function range and usability of communication software for elderly users.
Why use it?	<ul style="list-style-type: none"> - Test a product - Promote a lively discussion on a product - Learn more about a product than from a single-user test
When to use it?	<ul style="list-style-type: none"> - Testing
How to use it?	<ol style="list-style-type: none"> 1. The participants are provided with a short explanation of the product and how it is used. 2. They work on the given tasks, while continuously expressing their thoughts. The supervisor notes the difficulties that are experienced. 3. After the test, the difficulties mentioned when using the product are discussed to gain a better understanding of what caused the problem. 4. The results are presented to the consortium and product improvements are discussed. Video excerpts help show how the participants struggled.
When not to use it?	<ul style="list-style-type: none"> - When testing a product reveals serious weaknesses in the users - When users feel inhibited or pressured by others
Special hints	<ul style="list-style-type: none"> - Take your time when explaining the method to the participants - Make sure both the participants have an opportunity to discuss their thoughts - Make sure both feel free to express their thoughts
Further reading	<p>Hom, J. (1998). The Usability Methods Toolbox Handbook. http://usability.jameshom.com/index.htm</p>

3.3.3 Cognitive Walkthrough

A cognitive walkthrough is an analytical inspection method for evaluating prototypes from a user's perspective. A usability expert usually uses this method, but users or stakeholders can be included, as well. The testers take the role of a user and 'walk through' the different steps of using the product virtually, or with the support of the product.

Example: You want to evaluate the problems of elderly people using a mobile emergency device.

Why use it?

- Test the early stages of a product
- Understand different use cases and their process steps
- Evaluate the process steps and simplify them
- Evaluate the risks of using the product

When to use it?

- Testing

How to use it?

1. The system (prototype, storyboard, pictures, video, etc.) and the use case are introduced to the experts and other participants.
2. The participants note or discuss which process steps they would take for a certain use case problems.
3. The original solution of the use case problems is presented. The following questions are discussed:
 - o Would users find a solution to the use case problems themselves?
 - o Would users have different ideas for solving the use case?
4. Develop solutions to solve the potential usability problems.

When not to use it?

- If the product has already been developed further (use a proper usability test instead)

Special hints

- Make sure you have a clear defined use case when starting the process
- Be open to criticism and new ideas
- Choose the ideas that are best for improving the product, not the easiest to develop

Further reading

Mahatody, T., Sagar, M. & Kolski, C. (2010). State of the art on the cognitive walkthrough, its variants and evolutions. *International Journal of Human-Computer Interaction*, 26 (8), 741-785.

3.3.4 Paper Prototyping

Paper prototyping is a method for testing the functionality and layout of an interface before coding it. The participants solve use cases by using paper prototypes (e.g. sheets of paper) and continuously comment on it (“talking aloud”). The supervisor notes the problems they encounter with the task regarding usability problems.

Example: You want to test the structure/menu of a sports game to enhance the health of chronically ill seniors.

Why use it?

- Test graphical interfaces (e.g. web and software) before programming to ensure the product’s usability
- Understand others’ behaviour (e.g. navigation logic, placement of buttons, etc.)

When to use it?

- Testing

How to use it?

1. Create prototypes of your user interface on paper (e.g. through sketches)
2. The product and the task (e.g. use case) are introduced to the participants.
3. The participants try to solve the use case problems while thinking aloud (e.g. which button or menu item he or she would choose).
4. The supervisor hands the corresponding sheet with the mock-up of the graphical display to the participants. Steps 2 and 3 are repeated until all the use cases problems are solved.
5. At the end, the supervisor can ask the participants why they chose a certain item or what category or buzz word they expected instead. The feedback is incorporated into the improvement of the menu structure to better fit the way users think.

When not to use it?

- To conceptualise the menu of a graphical interface, use card sorting instead
- To test the visual design of an interface (paper prototypes only focus on the structure)

Special hints

- Don’t make paper prototypes from all the pages, but focus on the use cases problems that are relevant and help you to understand usability problems
- Generalise the findings for the overall interface
- You can use digital mock-ups (click dummies) instead of

paper prototypes (e.g. Axure, Balsamiq and Pidoco)

Further reading

Snyder, C. (2001). Paper prototyping.
www-106.ibm.com/developerworks/library/us-paper/?dwzone=usability

3.3.5 Selection List

A selection list is an evaluation method for a systematic and qualitative selection of product functions or concepts from a variety of collected ideas.

Example:

Having collected ideas for the various functions of an intelligent lighting system for elderly users in the understanding phase, you want to choose the best ones.

Why use it?

- Focus development resources on the most relevant ideas
- Systematically choose the best ideas

When to use it?

- Conceptualisation

How to use it?

1. Develop and agree on the selection criteria
2. Include ideas on the functions, use cases, or concepts found in the selection list.
3. Use predefined criteria to evaluate the ideas of the functions, use cases, or concepts. You can weigh each category or define 'killer criteria' for a more specific selection.
4. Evaluate each option within the consortium according to the defined criteria.
5. Exclude unsuitable options, pursue the others, or gather more information about unclear issues

When not to use it?

- When the feasibility of the different ideas is unclear (although this could be part of the evaluation criteria)
- When there are no choices to be made

Special hints

- Only compare ideas that relate to each other (e.g. don't compare design and functionality)
- Agree on a methodology beforehand
- You can also perform the evaluation online to involve more people

Further reading

Pahl, G., Beitz, W., Grote, K.-H. & Feldhusen, J. (2006). Konstruktionslehre – Grundlagen erfolgreicher Produktentwicklung – Methoden und Anwendung. Berlin, Heidelberg: Springer. (only in German)

3.3.6 Self-Documentation

Self-documentation is an ethnographic methodology to identify user needs and test solutions through self-documentation (e.g. writing and photos) in the user's living/working environment over a longer period of time.

Example: You want to analyse the problems that a user experiences with your AAL solution during a long-term field trial to uncover unforeseen events (or use cases) that you have not considered.

Why use it?

- Identify user needs
- Identify current solutions' shortcomings
- Identify current solutions' strengths

When to use it?

- Understanding
- Testing and iteration

How to use it?

1. Users have to document their use of a certain product / service, or their experience in a living/working situation
2. Users are given the necessary equipment to document their experience (e.g. a notebook, camera, electronic device, and a description of the application)
3. Users have to document their experience over a specified period (e.g. daily for 2 weeks)
4. Users hand in their documentation

When not to use it?

- When the solution is prone to faults/errors with regard to usage or technology
- When the solution needs constant explanation
- When users are unable to document their experience properly

Special hints

- Take time to explain the method to the users
- Make the experience fun

Further reading IDEO (2011). Human Centered Design (HCD) Toolkit.
www.hcdconnect.org/methods/self-documentation

3.3.7 Shadowing

Shadowing is an observation technique to collect information about a person's everyday activities and natural environment. It provides insights into complex behaviours or aspects of which the observed person might not be aware.

Example: You want to understand the daily routines and difficulties of professional caregivers in their natural working environment.

Why use it?

- Identify user needs
- Understand users' living/working environment
- Understand user behaviour
- Understand user activities

When to use it?

- Understanding
- Testing and iteration

How to use it?

1. The research team determines the most important target group and processes that should be analysed.
2. The supervisor visits and accompanies the participants in their natural environment, taking notes or photos (if allowed).
3. The supervisor may pose questions either immediately or afterwards. In either case, it is important not to influence or interrupt the natural process.
4. The obtained qualitative information is analysed with regard to typical or important routines, the limiting factors, or basic requirements in order to develop new ideas for supporting products or services.

When not to use it?

- When observing a person is not considered ethical
- When the person does not behave naturally when observed

Special hints

- Be sure to have a proper ethical evaluation
- Make the participants feel as comfortable as possible
- Tell the participants that they are not being tested and that they can't do anything 'wrong'

Further reading McDonald, S. (2005). Studying actions in context: a qualitative shadowing method for organisational research. *Qualitative Research*, 5 (4), 455-473.

3.3.8 Storyboard

A storyboard consists of simple cartoons to depict planned functions or services before actual implementation in order to determine possible weaknesses or critical acceptance issues.

Example:	You want to analyse elderly users' acceptance of playing chess with a robot, as well as the possible challenges or requirements that you might have missed.
Why use it?	<ul style="list-style-type: none">- Understand functionality with the help of pictures- Show a product's functionality in pictures- Discuss a product's functionality
When to use it?	<ul style="list-style-type: none">- Conceptualisation
How to use it?	<ol style="list-style-type: none">1. The consortium defines a list of potential functions or services.2. The functions/services are broken down into single process/interaction steps.3. The use cases are scribbled with a focus on the user's problem and the offered solution.4. The scenario seems more real if photos are added to the storyboard.5. Storyboards are then used as a basis for discussions within the consortium, or with stakeholders and users on the possible functions and user interactions.
When not to use it?	<ul style="list-style-type: none">- When designing user interfaces (use paper prototypes instead)
Special hints	<ul style="list-style-type: none">- This is a very good method for discussing more sensitive issues, as cartoons can be portrayed more neutrally
Further reading	Travis, D. (2012). Lean ways to test your new business idea. www.userfocus.co.uk/articles/lean_ways_to_test_your_new_business_idea.html

3.3.9 UTE Analysis

The UTE (user, task and environment) analysis identifies basic requirements that are based on the user characteristics, the task process and environmental conditions.

Example: You want to design a health-monitoring interface for elderly users while considering their requirements or restrictions, which originate from their characteristics (e.g. bad eye sight), the task (e.g. frequency of measurement), and the environment (e.g. compatibility with the user's computer).

Why use it?

- Better understand the needs of users in certain environments and for certain tasks
- Better understand the shortcomings of current solutions in specific tasks

When to use it? - Understanding

How to use it?

1. Specify the categories: user, task, and environment.
2. Describe the physical and mental interactions between the machine and the product
3. Analyse the collected categories and interactions
4. Define the product requirements
5. Document the findings

Special hints

- This is an excellent method to obtain an overview of users' needs and to develop or test ideas for products whose use depends on various circumstances

Further reading Spinhof & Calvi (2006). User and task analysis in a home care environment. International Symposium on Human Factors in Telecommunication.
http://www.hft.org/HFT06/paper06/26_Spinhof.pdf

3.3.10 Walt Disney Method

The Walt Disney method is a creativity technique to generate realistic and new ideas for products or services from different perspectives.

Example: You want to generate ideas on how to monitor users' vital signs at home and the advantages or disadvantages of this.

Why use it?

- Better understand users' needs in certain environments
- Better understand tasks of users
- Better understand current solutions' shortcomings regarding specific tasks

When to use it? - Conceptualisation

How to use it?

1. The participants are divided into 3 groups:
 - o The 'dreamers' generate ideas without mental limits
 - o The 'realists' consider the steps required to put these ideas into practice.
 - o The 'critics' assess the possible advantages and disadvantages of these ideas.
2. The workshop supervisor presents and explains the problem.
3. To begin with, the participants develop solutions in their group (in the first round, the dreamers assume a dominant role).
4. Ideas are discussed among all 3 groups
5. After a certain period (determined in advance), the participants switch groups until everyone has assumed each position once.

Special hints

- This is a good method to help people assume different roles, allowing them to be critical or creative
- Encourage the participants to act their roles instead of simply brainstorming

Further reading Dilts, R. B. (1994). Strategies of Genius. Volume I: Aristotle, Sherlock Holmes, Walt Disney, Wolfgang Amadeus Mozart. California, USA: Meta Publications.

3.3.11 Wizard of Oz

This is a simulation technique to perform usability tests with prototypes that do not yet work independently. The system is controlled or replaced by a human operator, simulating the planned system behaviour.

Example: You want to test caretakers' experience when they use a robot service before all its functions have been implemented or work perfectly (e.g. pattern recognition and independent actions).

Why use it?

- Test solutions before they are operational
- Understand possible usability flaws before too many resources are invested in the development

When to use it?

- Testing

How to use it?

1. The product and the task are introduced to the participant.
2. The participant interacts naturally with the system while the human operator manages/simulates the function of the system remotely (out of the participant's sight)
3. The supervisor remains in the background and takes notes about interesting aspects of the interaction.
4. In the end, the supervisor asks the participant about her/his experience and the aspects of the product that he/she liked or disliked.

When not to use it?

- When too many functions have to be simulated and the participant feels cheated or becomes frustrated

Special hints

- Focus on the functions that need to be tested
- Explain that the participant is not being tested, but don't mention that it is a remotely managed device

Further reading

Bernsen, N.O., Dybkjær, H. & Dybkjær, L. (1993). Wizard of Oz prototyping: How and when. In: CCI Working Papers in Cognitive Science and HCI.

4 OTHER METHODS OF A USER-CENTRED DESIGN

Next to methods that directly involve users or stakeholders into the different phases of the innovation process, the following two “methods” – persona and heuristics – can also be used in a user-centred design. Again, this is only a selection of user-centred design methods and has no claim to be exhaustive.

4.1 PERSONA

Persona provide a description of archetypical end-users or stakeholders, specifying their characteristics or demographics, for example, providing details about their lifestyle, budget, and affinity with technology.

- Example:** You want to view your AAL solution from your most important target users’ perspective (e.g. as a developer).
- Why use it?**
- To create a better understanding within the consortium about the users and stakeholders
 - To keep users’ and stakeholders’ wishes, desires and fears in mind throughout all the innovation phases
- When to use it?**
- Throughout all phases
- How to use it?**
1. The research team decides on the most important target groups or stakeholders of the AAL technology in development.
 2. Information about each target group is collected. Note: Individual archetypes are more interesting than ‘the average user’ (who does not exist).
 3. A persona card is created for each subgroup, describing its typical characteristics and demographics.
 4. The persona cards help innovators keep track of the users’ needs throughout the development. They can be shared with the consortium or be put on the wall, for example, when choosing the functions of the final product.
- When not to use it?**
- When there is a risk of oversimplification
 - When there is a risk of stereotyping
- Special hints**
- Do thorough research on the persona.
 - Do not overgeneralise; create an actual persona.
 - Find suitable, memorable names for the persona to which the consortium may refer.
 - Persona can be fun.

Further reading

Cooper, A. (2008). The origin of personas.
www.cooper.com/journal/2008/05/the_origin_of_personas

4.2 HEURISTICS

Heuristics (or guidelines, checklists) provide tools for an expert review of products and services, e.g. to evaluate an AAL solution or interface. Experts or project members apply them to quickly identify potential usability problems before the prototypes are tested with real users (note that heuristics are no substitute for user integration, but they avoid that users get too frustrated with obvious usability problems).

The advantage of using heuristics is that it replaces mere intuitive assessments by offering a set of sensible principles as a basis for design decisions.

The following table gives a short overview of some relevant heuristics for the design of websites, interfaces, or human-machine interaction in general. The principles of universal design are explained in more detail in the > **Knowledge Base**.

Name	Description	Comment
W3C (Web Content Accessibility Guidelines - WCAG)	Guideline to make web content more accessible to people with disabilities	Very extensive guideline
Research-based web design and usability guidelines (National Cancer Institute)	207 guidelines from more than 500 publications for web design	Very extensive guideline for web usability
Usability guideline for Accessible Web Design	75 heuristics for web design for people who are visually or motorically impaired	
EVADIS II	Tool to evaluate the task, user, and context in order to determine usability	Readily available and easy to use, but time consuming
AttrakDiff	Online tool to assess subjective usability	Free software, but without any insights on the methodology
ISO 9241	Standard consisting of (currently) 17 parts covering dialogue, user interaction, keyboards and gestures	Very extensive standards that can also be used for parts

Name	Description	Comment
Design for all (DFA)	Guidelines for various aspects of life, like housing, playgrounds, public toilets, etc.	Very broad concept that can be applied to many products
Universal design	Design concepts and guideline for various types of products	Similar to design for all
QUIS (Questionnaire for User Interface Satisfaction)	Questionnaire to measure the subjective satisfaction of human-machine interaction	Relatively easy to use

5 THE 'IDEAL' USER-CENTRED DESIGN PROCESS

In an ideal user-centred design process, the AAL consortium looks at users' and stakeholders' actual wants and needs, creates ideas to fulfil these needs, develops a product accordingly and makes sure that the product is not faulty or unsuitable. The solution will then of course be a full success on the market for the users, the stakeholders and for the solution providers.

In theory this should work well, but in practice the ideal user-centred design process needs to consider many restrictions and requirements. Most importantly, resources such as time and money are often scarce, and it is difficult to coordinate a consortium to perfectly integrate all user needs in the technical development.

However, as we mentioned in Chapter 1, there is no one ideal user-centred design process. Instead, all AAL project coordinators need to find the one that best suits their needs and resources. Project managers should not use this uniqueness as an excuse to allow the focus of an AAL project to stray from the most important stakeholder: the user!

This also means that the project's goals should remain realistic: Having too many different key users throughout the project will at best make the final solution less relevant for the different user groups and, at worst, make it useless for various or all user groups. Therefore, we suggest focusing your user-centred design process by approaching specific target groups with your solution. Therefore, the first step in every user-centred design process is to clearly identify and specify the user(s)! Both the literature and empirical research may be used to do this. The literature often reveals sufficient results about users and user groups, in which case you don't need to reinvent the wheel (the

> **Knowledge Base** provides some insights into the existing knowledge of about AAL user needs in AAL). If no data is available, or more resources are required to obtain this data, integrating users will help you understand (Phase 1) the market. This guideline introduces various methods for integrating users in order to better understand them.

Once the target group has been defined and understood, you will quickly realise whether or not there is a real need and market for your AAL solution (e.g. through > **Shadowing**, > **Self-documentation**). If there is no need, you should seriously rethink the user group and your project's goals. However, if you have found a need that you can satisfy and that also seems to make financial sense, you should move on to the next phase and thoroughly conceptualise the solution – from the creation and definition of the functionality to the user interaction, from the required service to the communication with the stakeholders as part of the marketing process. While a consortium might have great ideas for the product, integrating users into this creative phase has many benefits. Users not only contribute great new ideas and identify new solutions, but also help you create a first market: The users who feel they have an influence on a product often take ownership of this idea. Also referred to as ‘launching customers’, they might not only buy the solution later, but may also act as ambassadors for it.

Be sure not to reinvent the wheel during this conceptualisation phase! If you have done your research properly, you will be familiar with the existing solutions and the extent to which they address market needs. In other words, you know the competition well. If there is still an unfulfilled need, take this opportunity to improve existing solutions by incorporating users into the creative methods (e.g. > **Walt Disney method**) to establish what kinds of products could better fulfil their need.

We also encourage you to develop quick prototypes (e.g. > **Paper prototypes**, > **Wizard of Oz**, click dummies or even 3D-prints) in the conceptualising phase to test the product's practicability for users and improve the concept. This helps focus the available resources on solutions that matter!

Therefore, the whole user-centred design process needs to be iterative; it should take ‘slices’ of the final product that can be conceptualised, developed, tested and improved. The important trick in this slicing exercise is to not let the overall product slip out of sight or create island solutions. Therefore, we strongly urge you to create standards for user interaction, such as style guides for user interfaces that the whole consortium can use. This will unify the overall product and the results of the different learnings from the user integration can be made available to the consortium.

6 SUMMARY

This guideline gives an overview of the art and joy of user integration into AAL projects. Although many other disciplines besides from AAL can profit from the guideline and create better innovations, it is often necessary for AAL project planners to integrate users throughout an entire innovation process – from a first understanding of the market, idea creation and conceptualisation to testing and creating business models. There are two reasons for this necessity: The first is a lack of understanding of users' ever changing product needs due to the generation divide (e.g. developers of products are often much younger than the users) and the need divide (e.g. a developer's needs differ from those of others). The second reason for user integration is that AAL projects are mostly

obliged by their funding agreements to integrate users into the innovation process and to do so for a very good reason: to produce products that are relevant for the market and not only for science.

This guideline discusses the background of and methods for integrating users into the AAL product development process throughout all its phases. Although only a few methods are described, it provides a sound starting point for making user integration fun and efficient for the consortium and the users. We encourage project leaders to embark on a user-centred design journey with the goal to fulfil user needs in all projects and throughout all the phases of the innovation process. This will enable them to create products and services that are valuable, practical and hopefully successful.

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