# Fact sheet on public deliverables


Enhancing older adults' quality of life and improving the long-term sustainability of health and long-term care systems through Information and Communication Technologies (ICT), are at the core of the solutions investigated in the projects funded by AAL. Also, since demographic change is a major societal problem, ICT solutions are widely accepted as a potential key enabler to improve the autonomy and active participation in life of older adults.

Considering the transversal nature of technology, the short obsolescence period of all ICT products and the recent increasing adoption of paradigms like Internet of Things, Blockchain, Cloud Computing, Artificial Intelligence and the convergence towards a 5G, it is to be expected that most projects (especially those very close to market) will cope with frequent changes in devices, networks, protocols, thus allowing valuable solutions to last longer, to interoperate with third-parties and cope with market trends like DevOps and Continuous Development.

The AAL Programme asks for solutions to be based on existing standards and open platforms in order to improve interoperability; also, they should be reliable and safe, ensuring security and privacy by design; further, user interfaces should be simple, intuitive, personalised and adaptable to the changing abilities and requirements of primary end-users.

Regarding User Interfaces, there is a wide debate about the need for an appealing and engaging User Experience (UX) adopting, simultaneously, paradigms like Universal Design/Design for all which, by avoiding stigmatization, contributes to a wider potential acceptance of technology solutions that according to the Unified Theory of Acceptance And Use of technology (UTAUT) is influenced by factors like Performance, Effort, Social Influence, Facilitating Conditions (context, infrastructure

availability, …). Nevertheless, these are not the only factors influencing Technology Acceptance and user-dependent ones (Age, Gender, Experience, willingness to take risks) can alter behavioural intention and, therefore, influence ultimately the product, service or solution usage and its potential sustainability.

# Main findings from the analysis of the public deliverables


Firstly, the type of information provided by AAL public deliverables in the field of "Technology", is very heterogeneous, ranging from scattered and basic information to very extensive and comprehensive documentation (sometimes completely unexpected for the public nature of the deliverables). Also, it is noted that the AAL Programme has not established guidelines to develop technology-related documents, neither defined what kind of information should be made public.

Secondly, during the period in which the deliverables have been produced (2008 to 2018) many guidelines, standardisation initiatives and technology developments were produced, which makes it much more difficult to directly compare technology approaches or outcomes. It can be perceived that long adoption periods (either linked with technology acceptance, certification or market related issues) are also an aspect influencing the contents presented in public documents. This brings essential quality requirements for projects (and their developed products, services or solutions) that aim to strive in the market: maintainability and interoperability.

Main findings fork the analysis of these deliverables can be summarised as follows:

- **Standards and Guidelines**
  Throughout the AAL Programme implementation, many standardisation initiatives developed guidelines and regulations. These recommendations have emerged from multiple transnational bodies but, some of them, were initiated by national standardisations bodies (like in the United Kingdom or in France). These recommendations cover key areas like safety, interoperability, medical devices development, domotics and, recently, an AAL service definition (AFNOR, BSI, ISO). Yet, it is not clear whether, apart from a few projects, technology- related standards and guidelines were fully considered; in fact, projects were mostly focusing on standards related to usability and

user centred design, which is probably a reflex from the Calls' emphasis on these topics.

- **Medical Devices or not?**
  Some projects developed medical devices, including software platforms that register and analyse health data. It was expected that instead of avoiding the topic (probably because in the initial stages, partners were not considering the system/components as medical devices), consortia dealt with medical devices regulations in a preventive way. It is not fully clear whether, if health data were analysed, the medical devices directive or the guidelines and standards like ISO 13485:2016 were taken into consideration.

- **Privacy, Ethics and Certification**
  Though GDPR and the Medical Devices Directive (and other EU regulations) are now in use, every country still manages certification processes individually and establishes some potential peculiarities in evaluation and certification processes. This limitation leads to long lasting approval processes and, eventually, to extra expenses in preparing and translating documentation, especially in initial stages. It is also important to mention that, if trials require the usage of medical devices which have not yet received the EC label, the bureaucratic process is extensive and has to be followed in each individual scenario (and country), obliging beneficiaries to pay taxes and insurances multiple times. Additionally, it is not easy to contract an insurance to cover trials of medical devices which are not yet certified. This is still a clear limitation in projects designed to be transnational.

- **Technology Acceptance**
  Most projects have not developed a holistic Technology Acceptance analysis, which could probably contribute to develop a systemic view of each country and local conditions. In fact, models like UTAUT underpin the importance of contextual factors, user factors and willingness to accept and use technology. Some of these are linked to, for instance, qualifications but others are linked to technology availability (broadband, for instance).

  In parallel, some countries (like France, where most care is catered by mutualités and insurance companies) are contributing to define standards (some started as voluntary). This, in combination with ISO interest in ageing societies, may ease the adoption by public entities tied to procurement regulations.

# Main criticalities/weaknesses/gaps identified


As mentioned before, due to the heterogeneity of public deliverables among projects, it is not possible to develop a full and complete analysis, avoiding some biasing or some generalisation. The main points spotted during the analysis are:

- **Lack of State of the Art and Context Analysis**
  Many projects have not identified, as part of their public deliverables, the spotted needs or problems to solve, their proposed solution and general technology context. In some cases, it has been difficult to understand what the aims and the starting point were, only by going through the analysis of these deliverables and without analysing the full Description of Work.

  The lack of contextual background information as well as needs, challenges and proposed solutions limits the future usefulness of the deliverables, namely knowledge dissemination, but also may compromise requirements analysis and system architecture design. This is because it may lead to ignore, for instance, interoperability issues, relevant standards or guidelines or even existing frameworks, platforms or devices that could help accelerating development or, in opposition, substantially increase complexity, raise adoption barriers or, even, make it commercially unviable.

- **System Architecture Definition is not following a widely accepted and systematic process**
  Though in a few projects it was possible to recognize a systematic approach to state of the art reviewing, requirements analysis and System Architecture definition, most projects were not clearly following an accepted approach to develop the architecture like, for instance, TOGAF, providing adequate traceability between requirements, components, implementation and tests.

- **Documentation is not following a widely accepted representation**
  Though a relevant number of projects is extremely comprehensive in documenting technology development processes using standard or widely accepted representations, most projects are not providing diagrams in

standard notations. Nevertheless, there are exceptions and some projects are providing detailed representations of many diagrams using, for instance, UML representations.

- **Maintainability and Interoperability**
  Despite the fact that some projects provided information about multiple standards and viable solutions, from the analysis, it is not clear that requirements like maintainability and interoperability were fully considered in all projects, giving the developed solutions a longer life (especially in a domain that has longer adoption periods).

  In what regards interoperability, it was possible to identify concerns about supporting multiple communication protocols or, in a more advanced level, with semantic interoperability, using, for instance, ontologies. In some projects, comprehensively documented, used ontologies were defined by third parties and were widely adopted or were developed extending existing bases. Maintainability is ever more important. It concerns the traditional software maintenance activities but also the introduction of new features or replacing components. Most of the projects has not highlighted how, for instance, they could replace devices, software components, independently of their providers or future evolutions.

- **Security and Privacy by Design**
  Though security and privacy are explicitly mentioned in Calls' texts, many projects have failed to identify which components or techniques have been adopted in the system architecture for these purposes. Many consortia focused only on authentication and authorization, but skipped techniques like anonymisation, encryption and data separation. Even in what concerns authentication, most systems relied on basic authentication and have not considered approaches like certificates (which, in fact, may also be used with attributes in authorisation).

- **Technology Selection**
  Many projects, probably due to the lack of an extensive state of the art and market analysis and the nature of the deliverables, have not provided a comparative approach between existing technologies either to support their developments or to justify the features/functions present in market ready devices or solutions. This kind of analysis (if disclosed) could contribute to accelerate the industry, avoid mistakes and waste of resources in the future (though it is questionable if it needs to be public, at some point this can be disclosed if the consortium is using components/solutions made by others). On the other hand, especially in what concerns aggregation platforms and

communications, many initiatives, standards and reference architectures are disclosed, for instance, by consortia participating in large scale Framework Programmes' projects in other domains.

- **Lack of Critical Analysis and Future Work**
  Only a few projects documented prototypes and validation processes and have identified future work and learnings.

# Opportunities deriving from criticalities


After analysing the full repository of technology-related public deliverables, emerging key issues are probably linked with the future usefulness of the deliverables themselves, how to contribute to an effective knowledge dissemination, to promote a wider acceptance of ICT based solutions for an ageing society, how to improve older adults' quality of life and effectively contribute to reinforce EU (and partners) leadership in this area.

Regarding usefulness, it is recommended that besides an abstract, conclusions and future work sections, deliverables could start with a section that briefly explains the project, initial problem and expected solution. Documents should be "self-contained", meaning that they must be understandable without the support of another project documentation (especially when restricted or confidential).

It is also important that all projects develop and share documentation that is widely accepted as part of Research, Development and Innovation Project inputs (like the current market and technology state of the art, current limitations, the main outcomes and expected benefits). It is also important to identify the problem to solve, existing solutions (in the market, under research as well as their adoption and support level), standards, regulations and best practices in areas related to the project.

Considering a wider dissemination of projects, it would be important that projects – especially because most of them are targeting the market in a short period after development – could follow a systematic approach when developing the architecture, for instance, based on open and accepted frameworks like TOGAF (The Open Group Architecture Framework), providing traceability from business to technology implementation.

Of course, the provided details should be high-level and strictly limited to those required to have a broad perspective of the project and its potential connections (this could favour linkage among projects and cooperation relationships). Additionally, especially when presenting different views, partners should use standard or widely

accepted representations/nomenclatures like, for instance, UML diagrams. Following a standard approach (though development details and individual components are not required), would provide information about the selected infrastructure, main functional blocks, interoperability and extension points.

Another important artefact is related to technology selection and its justification: for instance, which sensors, which network protocols, which development frameworks could be used while providing data to compare different options (including frameworks/platforms coming from other domains).

### Technology Trends and Opportunities

As in any other domains, Information and Communication Technologies are enablers of specific AAL solutions. Therefore, its major developments and trends will necessarily influence novel solutions that result from concrete application of new knowledge and paradigms. Technologies likes 5G, Artificial Intelligence, Blockchain, Internet of Things, Fog Computing or Wearables will contribute to a new generation of AAL solutions.

5G, for instance, is not only a new paradigm in mobile communications: it allows the convergence of radio and optical networks and re-introduces distributed computing towards the edge as complement to "centralized" cloud computing. One of 5G distinctive capabilities is processing data and taking decisions near its origin, providing not only resilience, but also decreasing latency. This, for instance, may reduce the dependence of "powerful" home gateways as 5G is also providing convergence between broadband and narrowband communications, reducing hardware costs and enabling emergency response. 5G is the natural move towards Internet of Things usage in Fog Computing environments (combination of cloud and edge computing).

Blockchain (or distributed ledgers) is being used in an increasing number of domains (other than FinTech), providing traceability and trust across value chains, especially when combined with IoT. It is already common to consider it to fully trace increased value goods, adding sensor data automatically collected by sensors along the value chain and providing a fully transparent log of a specific product or service and, eventually, using it to enforce contracts (through smart contracts). This approach can also be useful, for instance, in tracking elderly care services, allowing fully transparent and trustable log of its provisioning to families, managers and health and care systems, bringing increased trust, improving the quality of services and, eventually, saving costs.

Wearables commoditization will, not only, contribute to increase the scope of data collection (big data will be evermore present) but it will also facilitate development of more sophisticated applications. Large companies like Apple, Samsung and Nokia are creating powerful smartwatches (able to run multiple applications) that are being

certified as medical devices and contributing to early detect potential severe health conditions, in opposition to initial positioning as “fitness” devices. These platforms are not only powerful and flexible but are recognized as high-end products which may contribute to reduce stigmatization and lead to wider technology acceptance.

Finally, Artificial Intelligence, especially Machine Learning, is contributing to optimize many services, allowing higher customization and increased automation. In AAL, it can be used not only to adapt interfaces to user needs but also to monitor elders' behaviour and anticipate (through patterns analysis) potential harmful situations (like initial depressive states or other health related conditions). Of course, other applications like artificial vision or natural language processing can be pushed towards new limits, providing easier interaction with users. Of course, this will require a robust ethical framework, protecting users but enabling innovation, a sometimes-difficult balance to achieve.