

Assistive Systems

Definitions and Application

Human Computer Interaction Group (HCI)

Institute of Visual Computing & Human-Centered Technology,
TU Wien

Winter Term 2019 / 2020

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Under partial use of scripts of Hochschule Furtwangen, Prof. Dr. Christophe Kunze

Blocked: 6 dates including today

Always Thursday 9:00 c.t. – 13:00

17.10., 24.10, 31.10., 7.11., 14.11., 21.11.

Venue: FAV Lecture Room 3 Zemanek (Seminar Room Zemanek)

Language: since 2019 in English

Lecture slides as documents (in English)

Slides are made available in TISS after each lecture block

Written examination expected from January 2020

Approximately 10 questions (in English) on topics that have been covered

Answers in English or German

Dates: 09.01.2020, 13.02., 12.03. (details and further dates: see TISS)

Introduction – Sequence of Course

I. Demarcation and Definitions

- Umbrella term AAL
- Technical Aids vs. Assistive Systems

II. User Interface (HCI)

- Active Support

III. Assistive Robots – Movement

- Human Robot Interaction (HRI)

IV. Sensors – are entering the living area

- Safety and Support

V. Ethics, Law and Economics

VI. Requirements Analysis and Evaluation

Understanding of „Ambient/Active and Assisted Living" (AAL) as inter-disciplinary field of application of Assistive Systems (AS)

Getting to know important factors from technology and application area

Learn typical application scenarios and solution approaches

Understanding of essential determining factors (economic, legal, ethical)

Understand basic types of Assistive Systems as networked AAL technology

Background of Assistive Systems

- Definition of terms:
AT, AAL, Assistive Aid/Tool, Assistive System
- Strategies
- Requirements

What stands „behind“ Assistive Systems?

Background of Assistive Systems (AS):

AT = Assistive Technology

*AAL = Active and Assisted Living
(earlier: Ambient Assisted Living)*

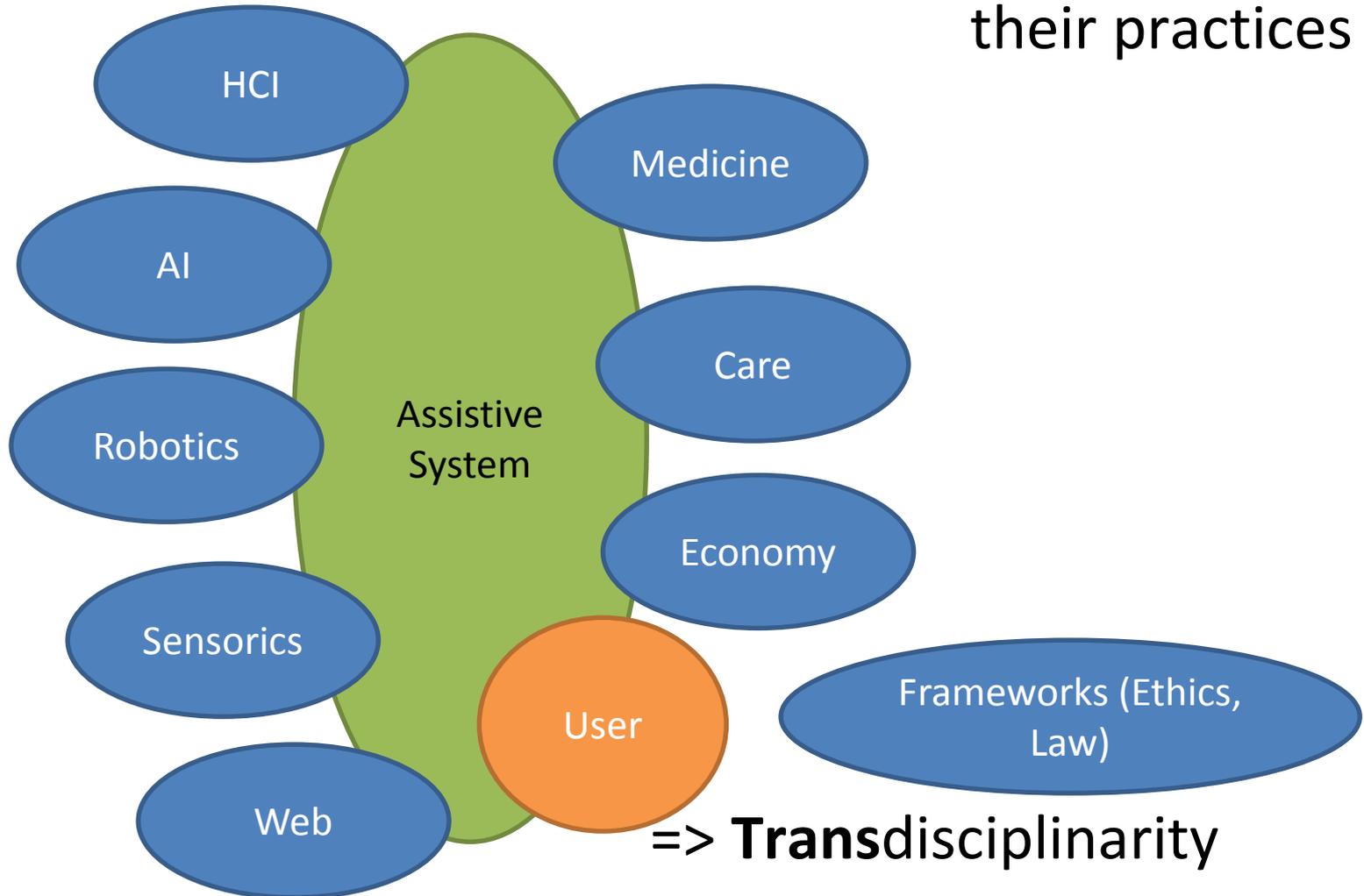
Background of Assistive Systems (AS):

AT = Assistive Technology (general term)

***AAL = Active and Assisted Living
(earlier: Ambient Assisted Living)***

- Technology, helping people in daily situations, often considered trivial
- Technology, helping helpers, do help more effectively and easily
- Technology, serving people instead of being served/handled by people
- Technology, which is easy understandable, because being „self-evident“
- AT is the „old“, broader term, coming from technology for disability
- AAL focuses more on the ageing society
- Assistive Systems exist both in AT and also AAL. We will concentrate on examples from AAL, but not exclude aspects of AT.

Affiliation with many special areas of knowledge and their practices



Assistive Systems (AS) – Active and Smart

- Assistive technology, which is more than ONE single tool != single assistive device/aid
- In AAL perspective it is no consumer product!
- Assistive technology which is interconnected (networked)
- Assistive technology acting in parallel to people and/or independently
- Assistive technology acting situation aware (as opposed to strictly user command oriented)

„Smart“? Systems

- Often (mis-)used term
- Misleading, because not really smart on its own, maybe just smarter than a single isolated tool
- But: **networking as system** can lead to synergies (Smart Meter as sensor for mains power, comfort/building control as actuator) and broader decision base

Both (AS and AAL) work in the same field:
technology as a supporting element in everyday life of
people

- AAL is a standalone "buzzword" for the main application field of AS
- Only by extending the "normal" AT to AS is AAL filled with meaning.

„Active/Ambient Assisted Living“ (AAL) means **concepts, products and services**, combining and improving **new technologies and social environment** with the goal to increase quality of life for people of all phases of age.

Maybe AAL can be best translated as „**age-appropriate assistive systems for healthy and independent living**“.

This does imply that AAL primarily targets the individual in his/her personal environment.

Demographic change as global mega trend

Since ca. late 1980s discussed among experts and
since ca. 2000 in politics and public's mind

The term „AAL“ first appears ca. 2004 in work groups
for preparation of research programmes

Origins also in:

Tele-medicine and e-health

„Ambient Intelligence“ and „Ubiquitous
Computing“

Main idea: technology can help solve problems

Who knows AAL applications in real use?

Where is the exact difference between „Assistive Device“ and „Assistive System“ and many similar (and popular) terms?



Video: <https://www.youtube.com/watch?v=D2udr6l9gjk>

Source: Innovationsplattform AAL Austria <http://www.aal.at>

We will discuss three main focal points in AAL:

- **Active User Interfaces** with assistive function and (Internet/info/communication) services
- **Sensorised „smart“ living environment** for support and detection of emergencies
- **Assistive Robots** with own movement and manipulation ability

Note: provided services are another layer

Now, for whom is this “AAL”?

AAL stands for Ambient / Active Assisted Living.

It sounds abstract, but it does mean something very concrete: the use of smart technology which makes life easier, safer and healthier - and that helps people live in their familiar home for as long and as self-determined as possible, especially when they are already dependent on support or care.

Already today there is a growing number of compelling AAL applications. They range from a small motion sensor, which gently switches on the light at night, to complex telemedicine services that enable medical care in one's own four walls, even in the case of a more severe illness.

Assistance systems can provide important support in many areas of life.

Due to the demographic development this help will be necessary.

With age, however, discomfort, impairments, and illnesses increase the need for support. But who should afford it when the relationship between older and younger people shifts more and more? With technology alone, this challenge can not be mastered. But it can make an important contribution.

AAL Magazin, 01/2010

(But so far, little practical results / products)

Ambient Assisted Living

- stands for **Technologies** and **Services** for independent living (primarily in old age)
- is a current field of research and application on the boundary between technology and demographic change
- is used as very heterogeneous term and is hard to confine and delimit from similar terms

Not one specific technology (or service)

Not one delimited product area

Not a technical-scientific discipline on its own

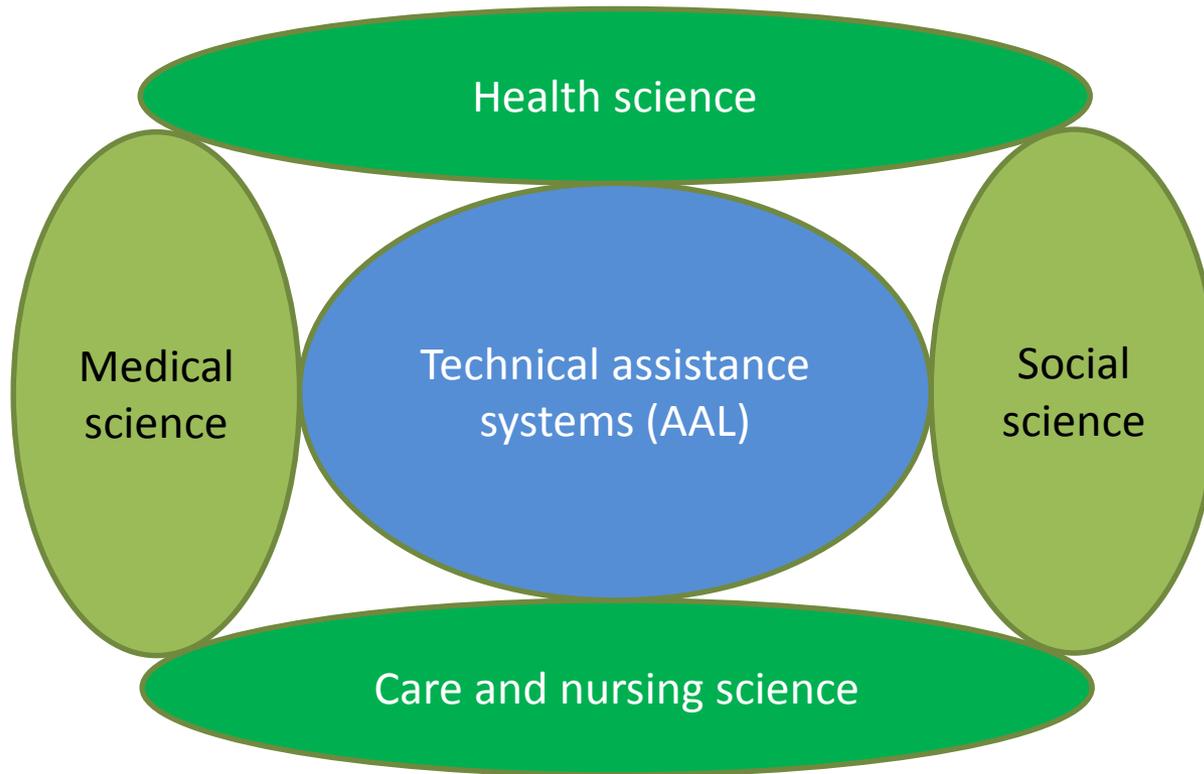
...

But more

a concept, a vision, a paradigm

an inter-disciplinary umbrella / meta concept

There is no AAL science



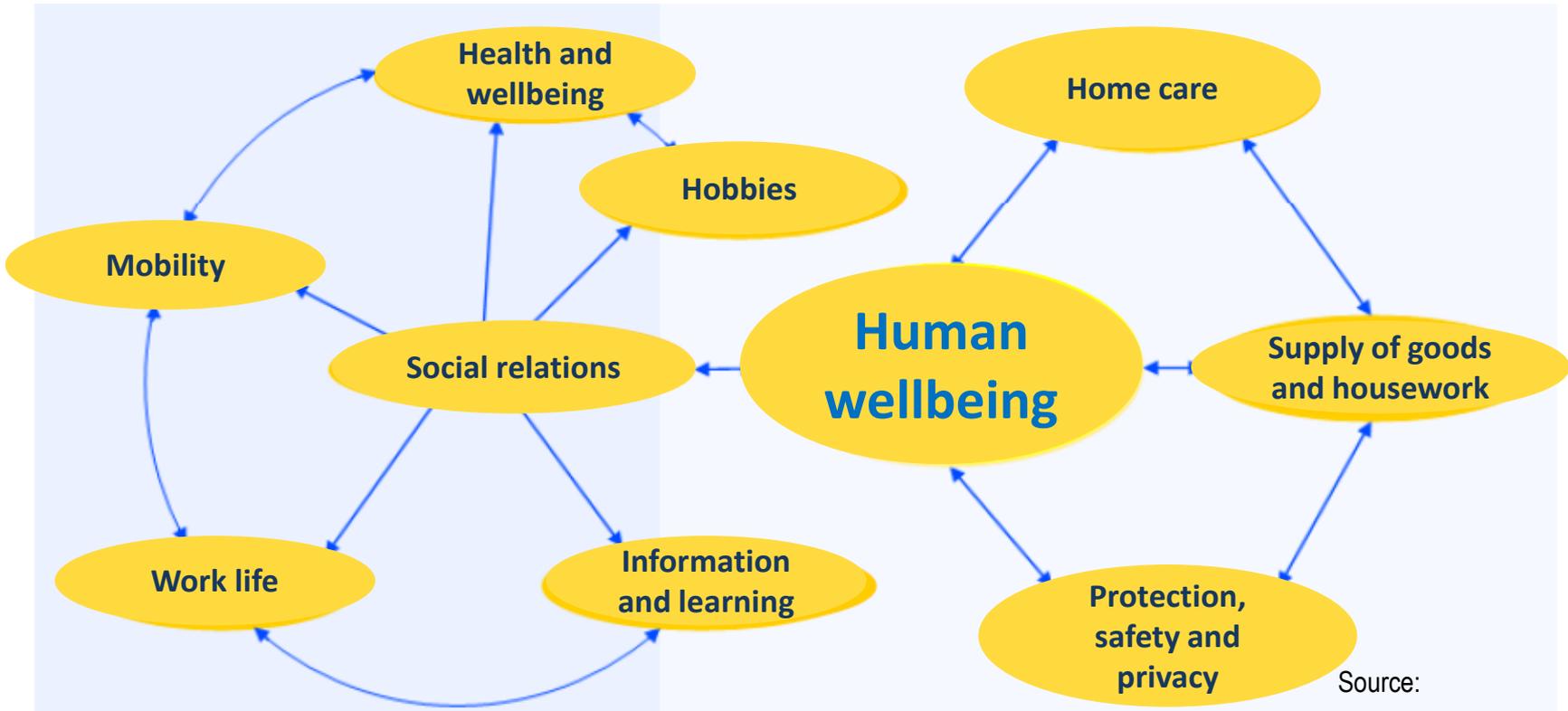
BMBF: Forschungsagenda Demographischer Wandel



Living with age-appropriate assistive systems

Environment

Home



Source:
AAL Joint Programme

Because it's so hard to grab it was discussed...



DPL-Phys. Ing. ROLF JOSKA
Produktmanager AAL, Gira Giersleben GmbH
et Co. KG, Elektro-Installations-Systeme

>> Gestern war es das Intelligente Haus, heute ist es AAL – Begriffe, die von Forschungseinrichtungen geprägt werden. Doch sind sie für die Markteinführung von Produkten geeignet? Tatsächlich kann sich kaum jemand aus der Zielgruppe unser der Abkürzung AAL etwas vorstellen. Die englische Bezeichnung „Ambient Assisted Living“ ist ebenso unverständlich. Stattdessen stigmatisieren sie. Meines Erachtens muss eine deutsche Übersetzung hier: „Altersgerechte Assistenzsysteme für

»FÜR DIE ZIELGRUPPE MUSS EINE VERSTÄNDLICHE DEUTSCHE BEZEICHNUNG HER.«

ein unabhängiges und gesundes Leben! Altersgerecht wird in der Regel als altersgerecht interpretiert, Assistenzsysteme werden von der Zielgruppe oft als überflüssig erachtet, und die Formulierung „gesundes Leben“ assoziiert Lösungen aus dem Bereich Telemedizin. Solange wir uns im Rahmen von Forschungs- oder Förderprojekten bewegen, kann der Name AAL durchaus verwendet werden. Für eine erfolgreiche Markterschließung allerdings sind die meisten der dort erarbeiteten Ergebnisse nicht vollständig übertragbar. Zwar sind Namen nicht nur Schall und Rauch, wichtiger aber ist die Wahl geeigneter Kommunikationskanäle, die Nutzung bewährter Vertriebswege und die richtige Kundenansprache. Für die einen ist es eben AAL, für mich sind es „Ausgewählte Anwendungen für mehr Lebensqualität!“ <<

22

das AALmagazin – 1/2011

HANS-PETER BRÖCKERHOFF
Herausgeber von E-HEALTH-COM und Mitglied der Arbeitsgruppe Kommunikation der Innovationspartnerschaft AAL

>> In der Fachwelt ist der Begriff AAL gelernt. Nicht nur in Deutschland, auch in Österreich und der Schweiz. Und auch auf europäischer Ebene wird er ganz selbstverständlich genutzt. AAL braucht deshalb in der Fachöffentlichkeit keinen neuen Namen. Im Gegenteil: Es wäre eher störend, jetzt eine Namensdiskussion zu beginnen. In Bezug auf die breite Bevölkerung ergibt sich ein anderes Bild. Hier dürfte man mit dem Kürzel AAL und auch dem Begriff „Ambient Assisted Living“

»BESSER KONKRETE INHALTE KOMMUNIZIEREN STATT EINEN NEUEN GESAMTBEGRIFF ZU SUCHEN.«

auf wenig Verständnis treffen. Den Begriff mit viel Kommunikationsdruck auch in der Bevölkerung zu verankern, erscheint wenig ratsam. Erstens wäre das sehr teuer und zweitens wenig erfolgversprechend, da sich hinter dem Begriff so viele unterschiedliche Sachverhalte verbergen. Also vielleicht doch einen neuen Namen für die normalen Bürger? Die differenzierenden Inhalte sprechen eher dagegen. Die bisherige Suche nach selbsterklärenden deutschen Begriffen war denn auch wenig erfolgreich. Entweder waren die neuen Begriffe zu lang und kompliziert oder sie gaben nur Teilaspekte wieder. Vielleicht sollten statt eines neuen Gesamtbegriffs besser intelligente Kommunikationskonzepte entwickelt werden, die helfen, die einzelnen Inhalte jeweils sehr verständlich und nachvollziehbar zu machen. <<

DR. HEIDRUN MOLLENKOPF
Mitglied im Expertenrat der BAGSO e.V. (Bundesarbeitsgemeinschaft der Seniorenorganisationen)

>> „AAL – was ist denn das?“, werde ich sofort gefragt, wenn ich den Begriff bei Vorträgen, in Workshops oder auch im persönlichen Gespräch gebrauche. Niemand weiß so richtig, was es bedeutet, und die verfügbaren Definitionen sind zumindest für den Alltagsgebrauch reichlich abstrakt. Braucht AAL also einen anderen Namen? Sollte jeder und jede sofort wissen, was damit gemeint ist? Ich meine: Nein, und zwar aus zwei Gründen. Zum einen ist tatsächlich kaum abgrenzungsgenau

»DIE IRRITATION ÜBER DEN NAMEN BIETET DIE CHANCE, KONKRET NACH ANTWORTEN ZU SUCHEN.«

definierbar, was der Begriff alles an technischen Systemen und damit verbundenen Dienstleistungen abdeckt. AAL-Technologien und -Dienste eröffnen im Grunde unbegrenzte Möglichkeiten von Person und Umwelt verbindenden Unterstützungs-, Informations-, Unterhaltungs- und Versorgungssystemen. Zum anderen bietet die Irritation und damit einhergehende Nachfrage die Chance, konkret auf die Fragenden einzugehen und Antworten zu suchen (und hoffentlich auch zu finden), die ihrer spezifischen Situation gerecht werden. Denn das gemeinsame Interesse aller potenziellen Nutzer und Nutzerinnen von AAL ist zwar ganz allgemein eine Erleichterung bei der Erfüllung ihrer alltäglichen Aufgaben. Aber worin diese bestehen und welche Anforderungen sich daraus für AAL-Systeme und -Dienste ergeben, kann sehr unterschiedlich sein. <<

das AALmagazin – 1/2011

DIETRICH GOHLKE
Mitglied der Senior Research Group an der TU Berlin

>> Sucht man im Internet nach AAL, kommt nach diversen Links zum Aal ein erster Hinweis auf „Ambient Assisted Living Joint Programme“ und nach „Angeln auf Aal“ der „4. Deutsche AAL-Kongress 2011“. Richtig fündig wird man erst auf den Internetseiten der BMBF/VDE-Innovationspartnerschaft AAL, die ausführend gestaltet wurden. Für den „ungeübten“ Interessierten tauchen dabei Namensprobleme auf. Im großen Rahmen von AAL findet man ein Spektrum von Bezeichnungen, von

»NAMEN SIND SCHALL UND RAUCH. AUF DEN INHALT KOMMT ES AN.«

„Altersgerechten Assistenzsystemen“, „Humanzentrierten Assistenzsystemen“, „Altern lebenswert gestalten“ bis hin zu „Webbasierten Diensten für ältere Menschen ...“. Je mehr ich mich in AAL einarbeite, desto mehr Begriffe tauchen auf, aber umso schwerer fällt es mir, einen möglichst eingängigen Namen anstelle von AAL zu finden. Damit erinnere ich an die alte Programmierweisheit „Namen sind Schall und Rauch“, will sagen: Auf den Inhalt kommt es an! Dieser Inhalt ist der Schwerpunkt des Vorhabens und fordert den Experimentat, AAL nicht nur zu den „nicht-technologischen“ Aspekten, sowie das BMBF und den VDE, ein äußerst strenges, inhaltliches Projekt-Controlling zu führen. Wenn es dann noch gelingt, die Projektergebnisse allgemein verständlich darzustellen, sollte das Ziel erreicht sein und Überlegungen zum Namen werden in den Hintergrund treten. <<

Quelle:
AAL-Magazin,
Ausgabe 1/2011

23

Altersgerechte Assistenzsysteme

Lebensassistenzsysteme

Umgebungsunterstütztes Leben

...

Distinctions: Assistive Systems are no „Assistive Aid“

Assistive Aid/Device (German: „Hilfsmittel“)



Definition: „Assistive Aid/Device“

Term from social insurance system, a thing used for medical support listed in an index of admitted = paid-for aids (German: „Hilfsmittelverzeichnis“)

AAL systems can be or become admitted assistive devices (nowadays rare cases)

„Classic“ aids (especially purely mechanical solutions)

- do not qualify as AAL solution
- but can be of high value for users!!

Most admitted/paid for aids nowadays are medical products prescribed by doctors

Medical treatment, counselling etc. must only be done by authorized persons (physician or equivalent)

Objects or substances, used for medical, therapeutic or diagnostic **purpose** on humans are regulated by the Medical Device Act (German: Medizinproduktegesetz) if no pharmaceutical.

AAL solutions can be MPs, but need not be, **safety of product must be given anyway** – CE sign

All products for consumers are governed by product safety regulations (CE sign). In the context of old, vulnerable persons special care has to be taken!

Smart Home („Intelligent living“) denotes systems and technologies for interfacing and controlling devices and services in the house (e.g. light, blinds, ...)

Smart Home technologies can be an important basis for AAL services but offer rather comfort functions than support in case of real needs.

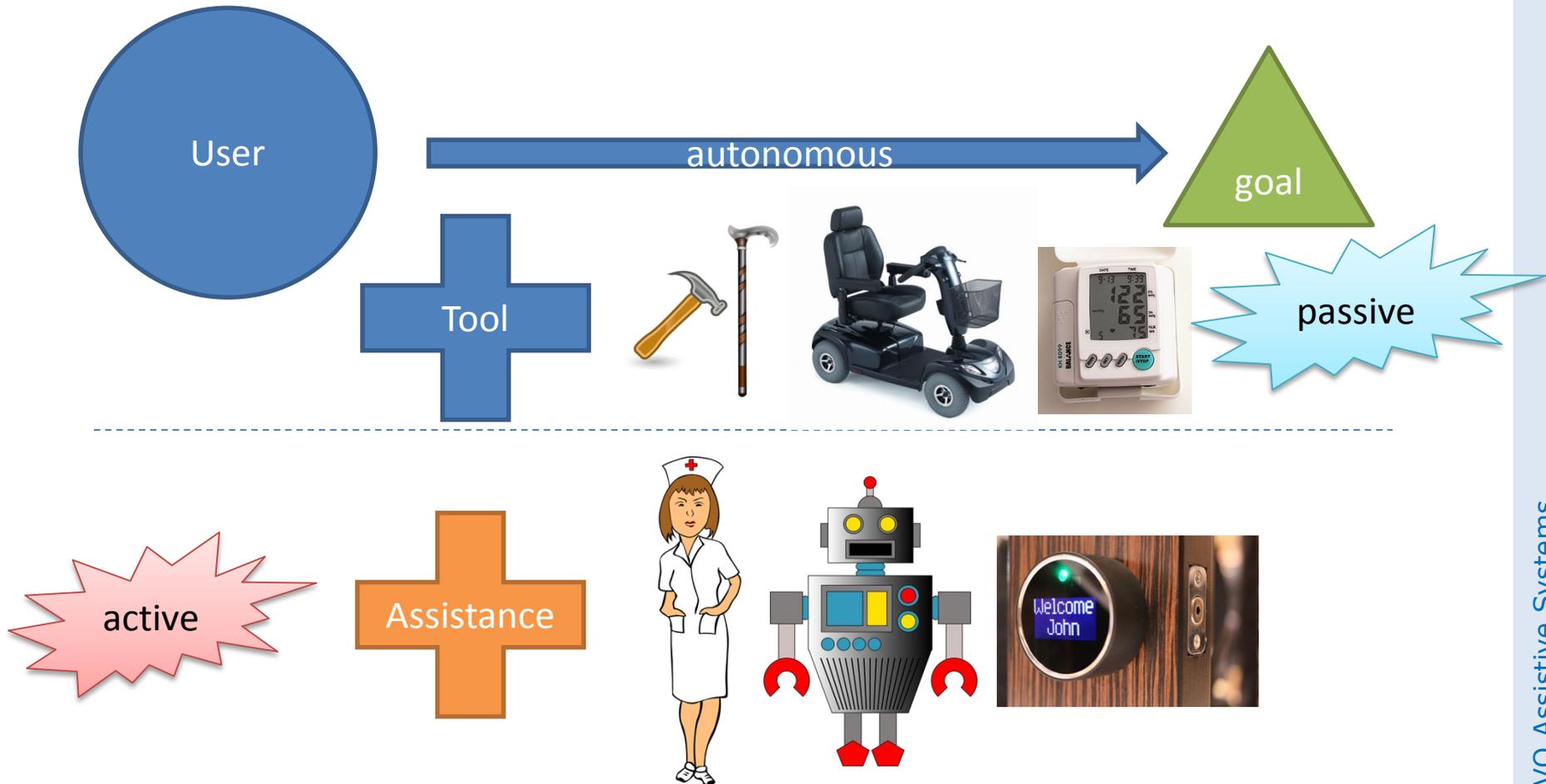
AAL is not limited to „in house-centric“ applications (Mobility, health, sustenance and supply, ...)

Needs of Daily Living go beyond comfort

Who owns or knows a Smart Home System?

Difference of assistance in acting: AS are themselves active

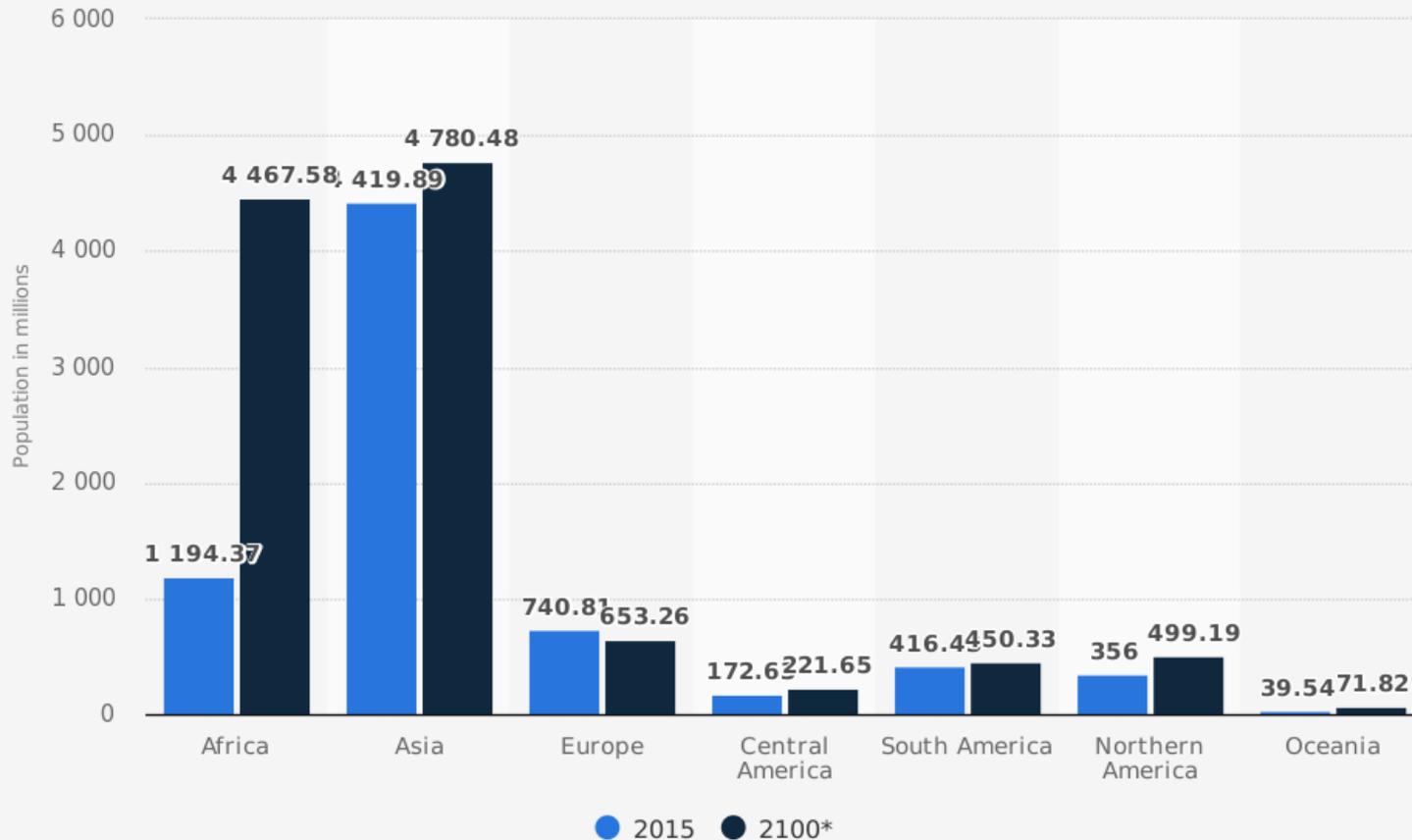
Goal is to stay autonomous with tools (passive)
or get **active** personal or technical assistance (AS)



Demographic Change & Situation in Austria

Background: Population forecast

Forecast of the world population for 2100, by continent



Source
United Nations
© Statista 2018

Additional Information:
Worldwide; United Nations; UN DESA; 2017

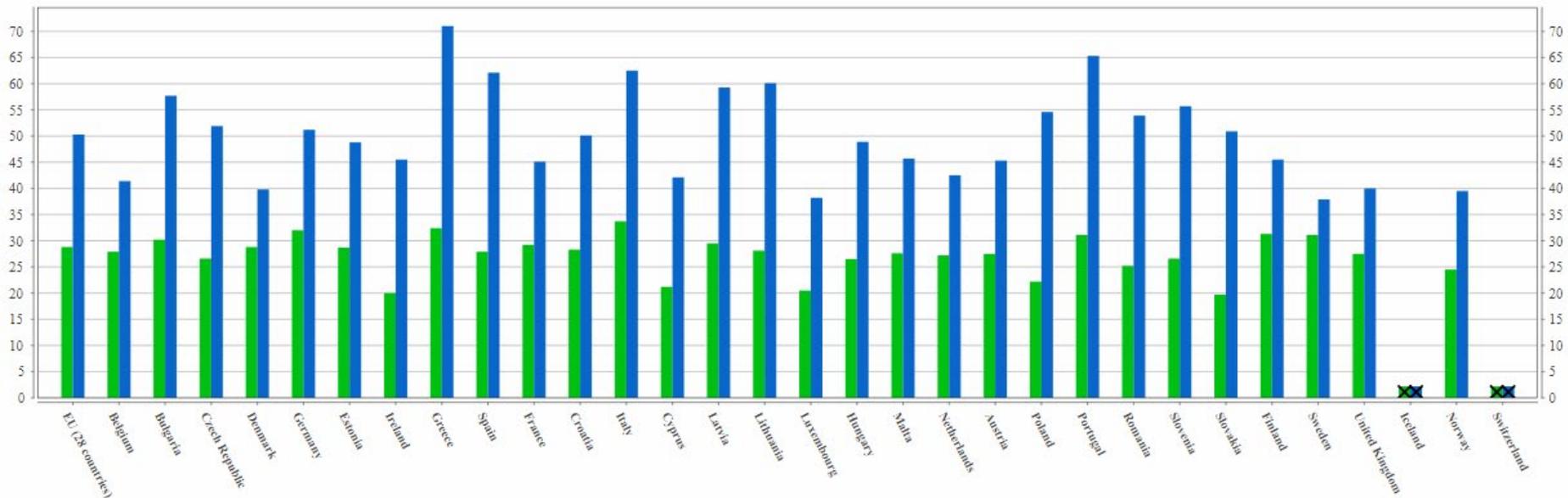
Background: Ageing Europe/EU 2015 - 2050

Ratio between the projected number of persons aged 65 and over (age when they are generally economically inactive) and the projected number of persons aged between 15 and 64.

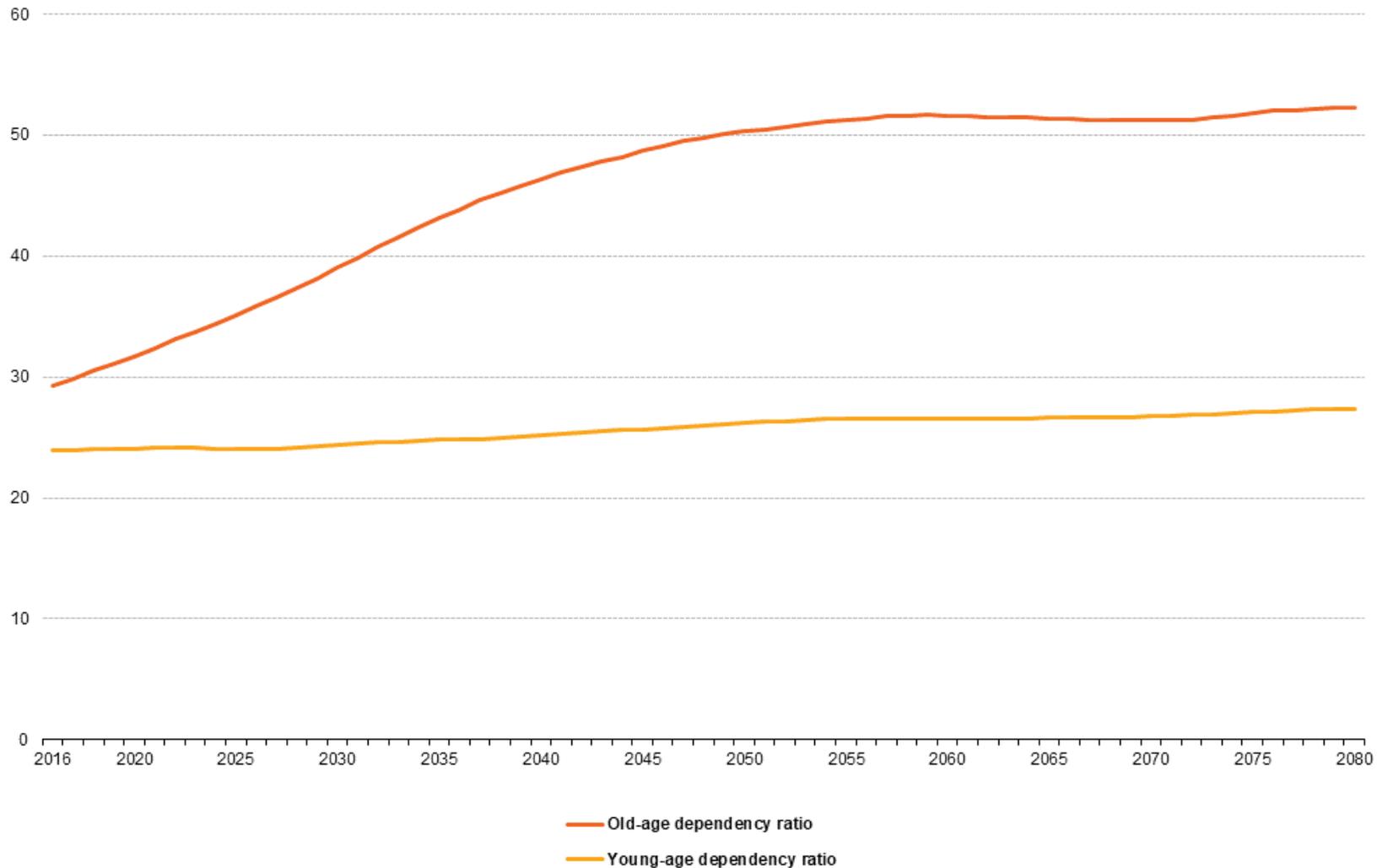
The value is expressed per 100 persons of working age (15-64).

(The green bars show situation in 2015 for several European countries, blue bars show increase forecast for year 2050).

Source: eurostat 2016



Dependency ratio: Europe/EU 2017 - 2080



Note: 2016, provisional. 2017-2080: projections. The old-age dependency ratio is defined as the ratio between the number of persons aged 65 years and over to the number of persons aged 15-64 years, expressed as a percentage. The young-age dependency ratio is defined as the ratio between the number of persons aged 0-14 years to the number of persons aged 15-64 years, expressed as a percentage.

Source: Eurostat (online data codes: demo_pjanind and proj_15ndbims)

The „Demographic change“ in nearly all industrialised nations means ...

1. increased life expectancy
2. birth rates decline
3. huge age group (Baby-Boomers) retire
4. mobility (more new residences) increases, more elderly people live in single user homes
5. less people working, more people to care for

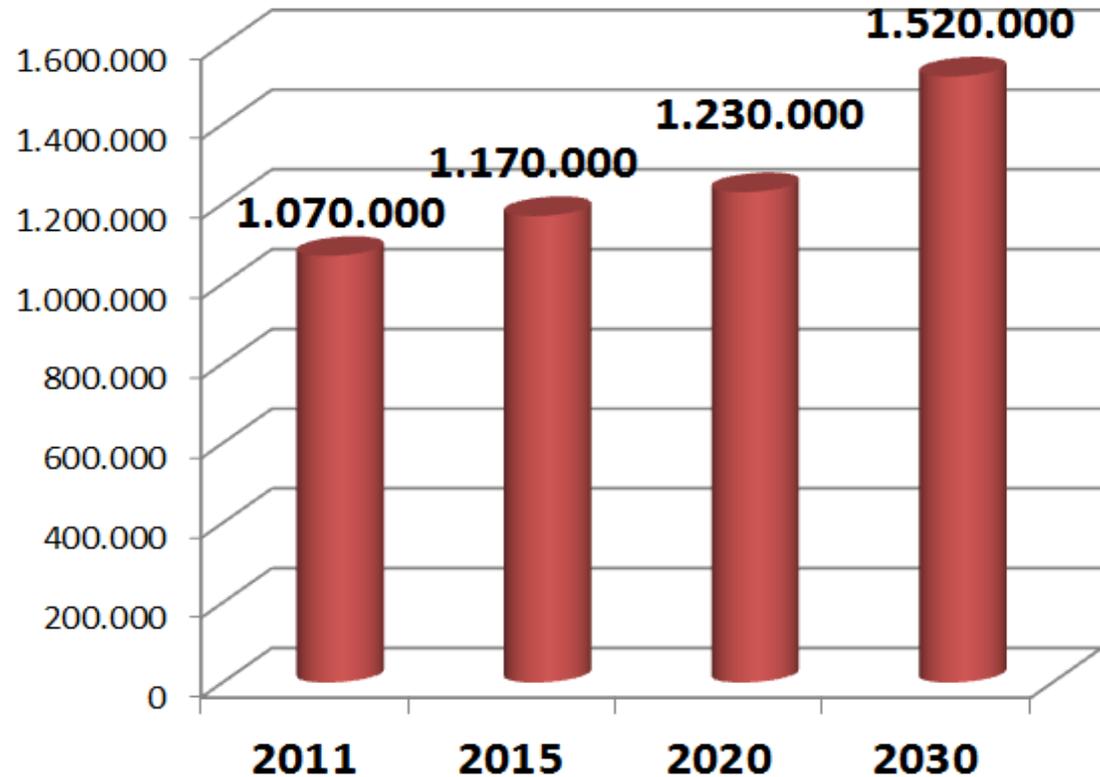
*The path towards innovation leader
Exploit potential,
Increase dynamics,
Create the future*

*Strategy paper of (former)
Austrian Government
on Research, Technology and
Innovation*

Austria, March 2011

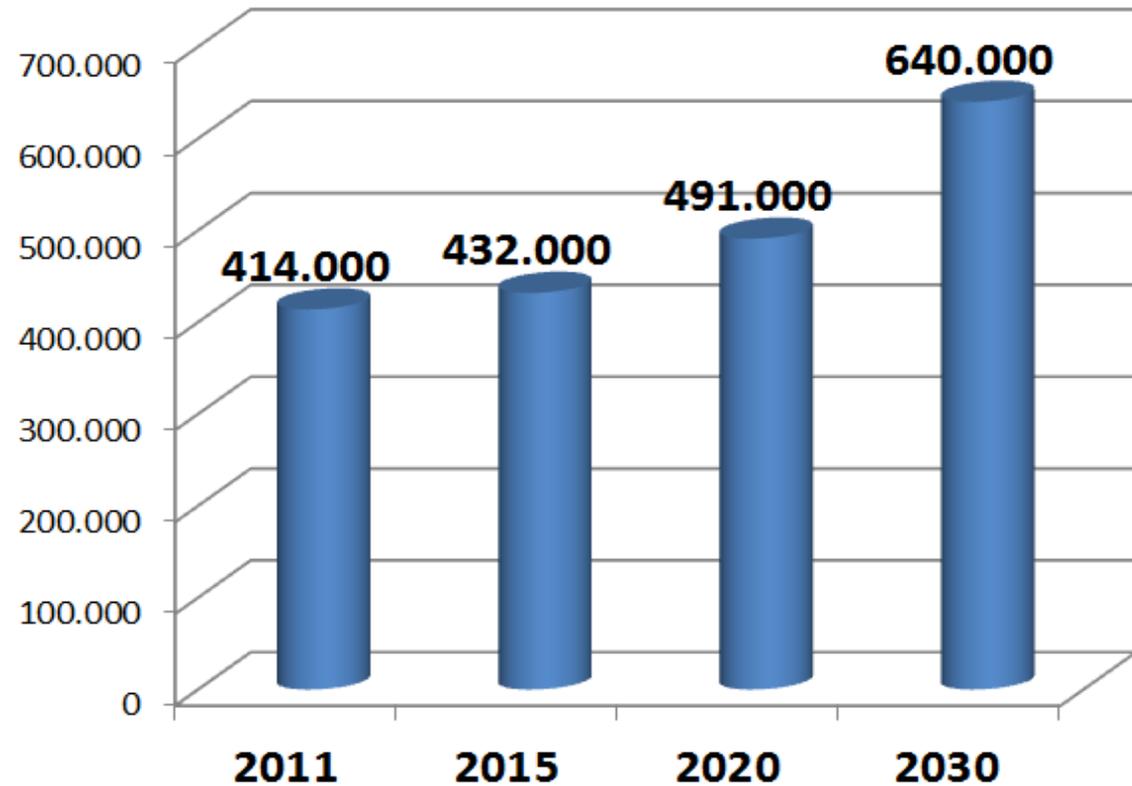


Austria
„Young old“
65 to 79 years



Zuwachs absolut: 60.000 290.000
Zuwachs per anno: 12.000 29.000

Austria
„Old and
very old“
80+ years



Zuwachs absolut: 59.000 149.000
Zuwachs per anno: 11.800 14.900

What choices have old people if they no longer can manage daily living on their own?

What choices have old people if they no longer can manage daily living on their own?

- Try to cope themselves
- Personal assistance (relatives or professionals)
- Change to senior residence or care home
- Technical assistance

- Mix all possibilities

Most important: it should be really THEIR choice!

The possibility to „get old“ staying in one’s own home is favourable:

91% of older people want to stay in their homes in old age, as long as possible

Mobile support and home care are significantly cheaper than care homes

Studie: Nur wenige wollen ins Heim

Nur neun Prozent von über 6.200 Befragten können sich vorstellen, den letzten Abschnitt ihres Lebens im Heim zu verbringen.

Das ist eines der aufschlussreichen Ergebnisse einer aktuellen Untersuchung in Deutschland. Nach Ansicht der Bundesinitiative Daheim statt Heim sind die Resultate ein klarer Auftrag an die Politik.

This means:

All measures that allow older people to stay longer in their current living environment and all measures that prolong the independence of an aging person ...

... bring a double profit!

- Higher quality of life
- Reduction in public and private costs

Work program of Austrian government 2013-2018:

„In order to prolong the independence of older people in their usual living environment and to support family caregivers, especially children, the following measures should be taken: [...] development of application-oriented AAL programs (technologies, products and services) with a focus on their sustainable implementation. [...].“

Current Situation

Assistive Technology already throughout our Life

But - isn't technology already there?



<http://www.autobild.de/>

AT and AAL are used in all areas of daily life.
They range from Lo-Tec to Hi-Tec.

but! - They should (even at Lo-Tec, if not a simple tool)
always provide a way to connect to modular systems
-> Assistive systems

Not only technical questions but also those of
(situational) acceptance and ethics play a decisive role

AAL is applied mainly in following areas:

1. Increasing safety
2. Communication and social participation
3. Health, care/support and medicine
4. Activities of daily living
5. Play and learn
6. Mobility
7. Comfort, wellness, lifestyle
8. (workplace – 55+)

AAL has several users:

1. Primary users: old person (mostly at home)
 - allows more independence
 2. Secondary users: relatives, live at distance, -
 - reduces concerns and burden
 3. Secondary users : support and care staff, therapists.
 - reduces effort, helps in assessment
 4. Tertiary users: funders, society
 - reduces costs, keeps people (socially) active
- It should work for all of them**

Concrete examples of „building blocks“ for Assistive Systems

Products and projects

Example:
Stove monitoring
Switches off when
a critical temperature
is exceeded and after
a set time has elapsed
(5..250 minutes).

But: on the market
so far only for
electric stoves

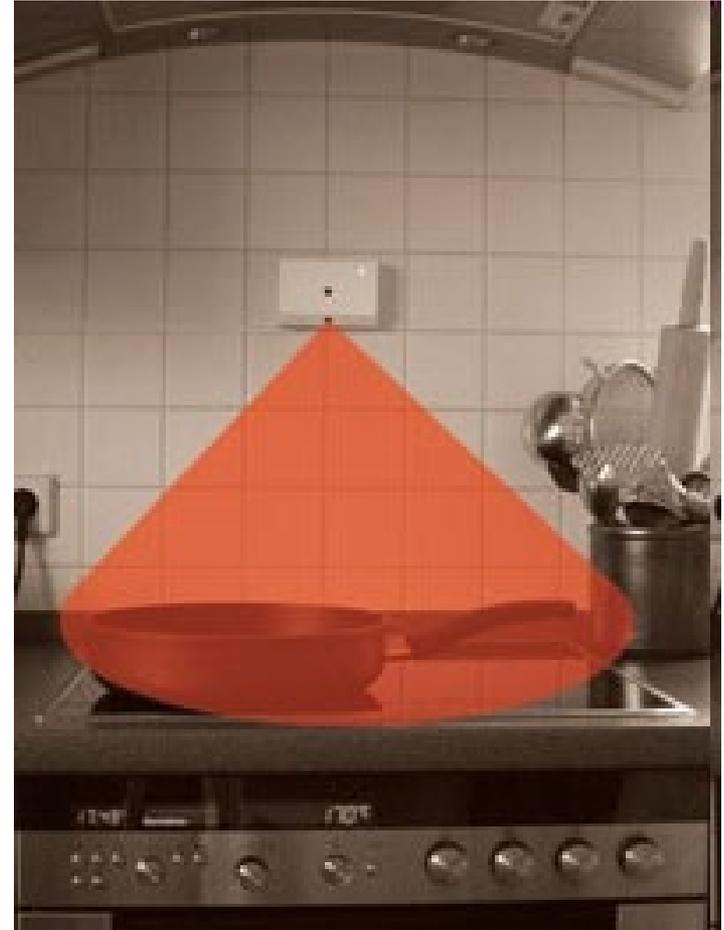


Image: www.rehatronik.at

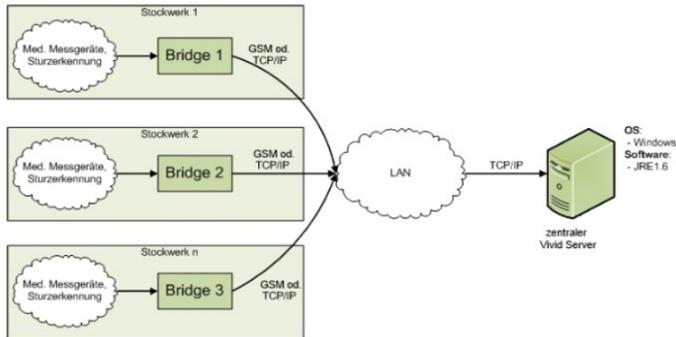
Example: night light with RF link

Base station with sensor
(Master, mains power).
Additional lights are triggered
by master via RF
(battery operated,
can be easily placed).
Reduction of fall risk.
Can be used as sensor
in an AAL System.

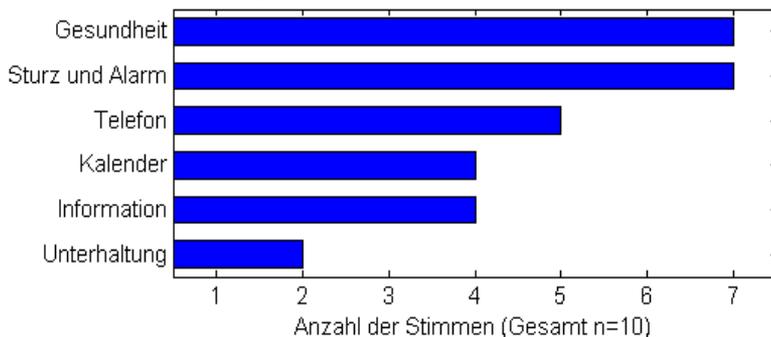




Combination of (a) body worn and (b) fixed fall detector (floor vibrations) with vital parameter measurement and touchscreen



Reihung CongeniAAL Funktionen nach Stellenwert



Demo on AAL Summit Wien 2014

<https://www.aat.tuwien.ac.at/congeniaal/>

Support for night shift – Project signAAL

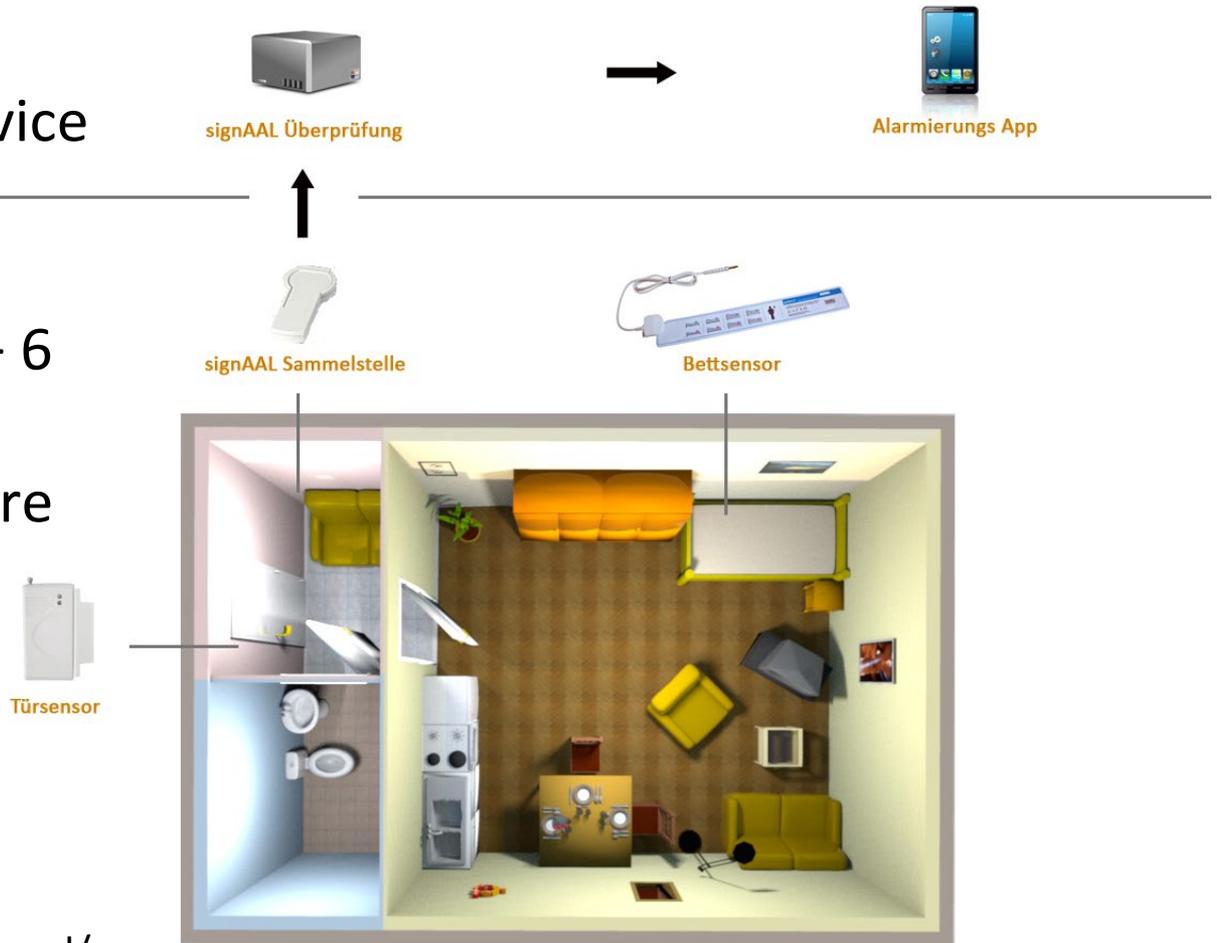
Dedicated AAL system for detection nocturnal activities.

Relief for night service

Increased security

6-month trial in 6 + 6 apartments

Link to nursing / care documentation



Example: Video telephone, information



https://www.tuwien.ac.at//aktuelles/news_detail/article/8007/

Example: Video telephone

Easy to handle

Creates social closeness

Fits the apartment better than a PC - sort of "furniture"

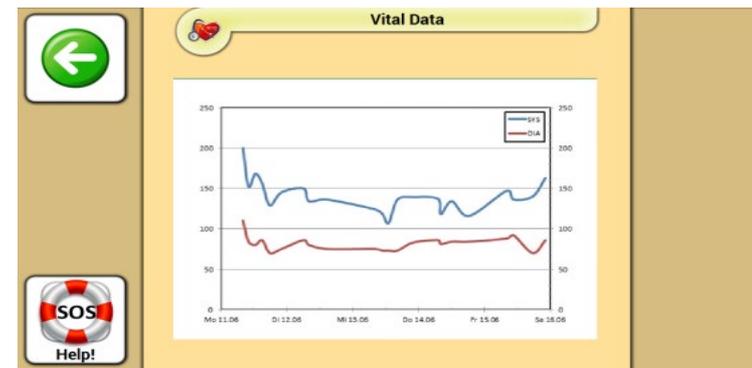


Example: Transmission of vital data

Daily measurements e.g. Blood pressure or blood sugar can be transmitted to the doctor.

The user can also easily follow the measured values on the screen.

An immediate and vivid feedback is thus given.



Example: Smart toilet

Height adjustable, tiltable, large surface, handles



<https://www.is.tuwien.ac.at/fortec/reha.d/projects/frr/frr.html>



Image w/o docking

Example: The fully fledged mobile toilet for use at the bedside.

Battery operated, therefore without cables and hoses.

Motorized stand-up aid.

Water rinse and automatic cleaning.

Draining and filling via automatic docking station (staff does not come into contact with fecal matter).

Example: "dry shower" for bedridden patients

- Water is sucked off immediately after application



<http://www.aat.tuwien.ac.at/isu/>

Example: Smart door

Door connected with videophone.

Dialogue options also for people with reduced speech

Motorized door opener (James)

Access with key, code,
card or smartphone possible.

In case of emergency call,
rescue teams receive a
temporary access code.

<http://www.aat.tuwien.ac.at/diaalock/>



Example: Assistive Robot



KSERNA (NAO)

<http://www.aat.tuwien.ac.at/ksera/>



DOMEEO (Kompai)

<http://www.aat.tuwien.ac.at/domeo/>



HOBBIT

<http://hobbit.acin.tuwien.ac.at/>

Project **DOMEO** With robot „Kompai“

- Can you see a problem?



<http://www.aat.tuwien.ac.at/domeo/>



Project KSERA:
Robot NAO in a
talk with old
people

HOBBIT: first lab-prototype
bringing a glass of water



HOBBIT Prototype 2 in real life test in

- Wien,
- Lund,
- Heraklion



<http://hobbit.acin.tuwien.ac.at>

Building blocks are already useful by themselves

In cooperation as a system, however, their benefits can be multiplied

The advantage of a system is particularly evident when parts are interchangeable and existing building blocks can be integrated / networked

A system also monitors itself and its parts

AAL Market and Research

The market potential of AAL is indisputable.
This is supported by many studies and statistics.

Driven by the demographic change a growing, profitable target audience for economy is developing – from the active 50+ generation to old age people. AAL has been and still is subject of numerous national and international research projects. In order for AAL solutions to develop successfully in economic terms, innovative, modular business models are needed.

The AAL market is "different".

Unfortunately, there were some failures due to bankruptcy or product discontinuation, such as:
HomeButler (comprehensive Smart Home solution with services, security components and communication)
iResidence (fall detection and telemedicine)
James (door opener for retrofitting)

Main reasons:

- Market does not start in time
- Indirect financing via social system
- Acceptance problems (price, design, stigmatization)
- Individual solutions, isolated solutions
- Gap between research and market
- Lack of proof of (relevant) benefits

As a concept and field of activity, AAL has hitherto been strongly research-driven, in many parts also technology-driven

Starting point: Political objectives and (Research) promotion

"There is no reason for older people in Europe to miss out on the benefits of new technologies. The solutions and services resulting from this programme will help them to remain active in society as well as staying socially connected and independent for a longer time,"

Viviane Reding, former EU Commissioner for the Information Society and Media.

Funding Program AAL-JP

(EU + national funding programs in many European countries) e.g. via FFG / bmvit (Ö) about 3M € / year

In the EU - approx. 700 M € Budget 2008 to 2013, approx. 40 M € per year until 2020, see www.aal-europe.eu

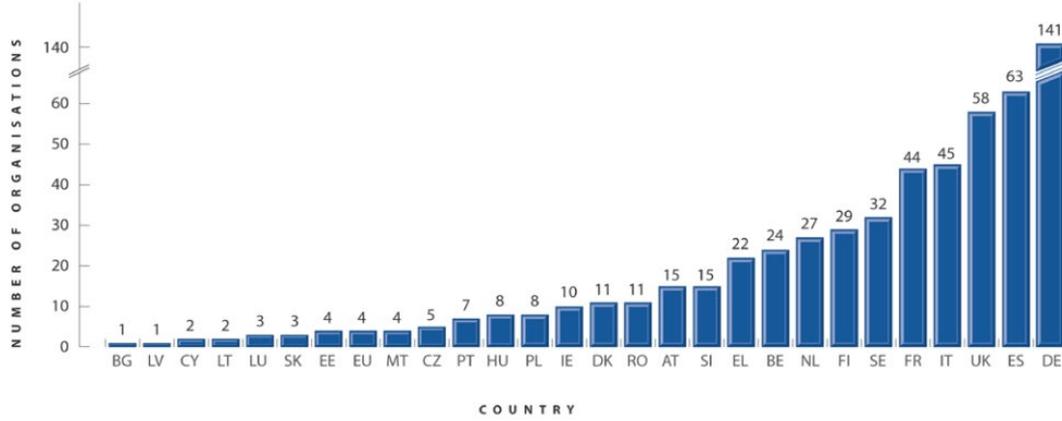
Communities and working groups:

- AAL Forum www.aalforum.eu
- AAL Austria www.aal.at

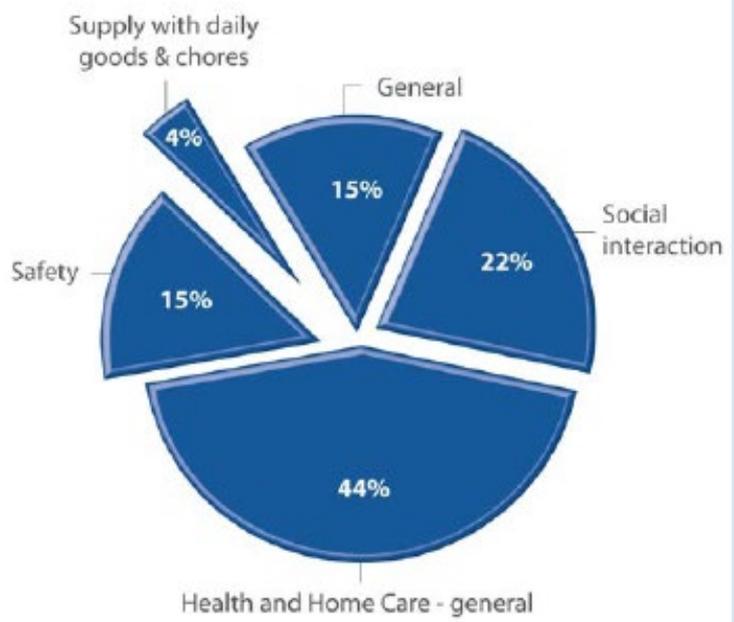
Additionally, research funding in related fields: ICT, Health



Number of organisations active in AAL research projects in EU-27



Ratio of research topics in European projects

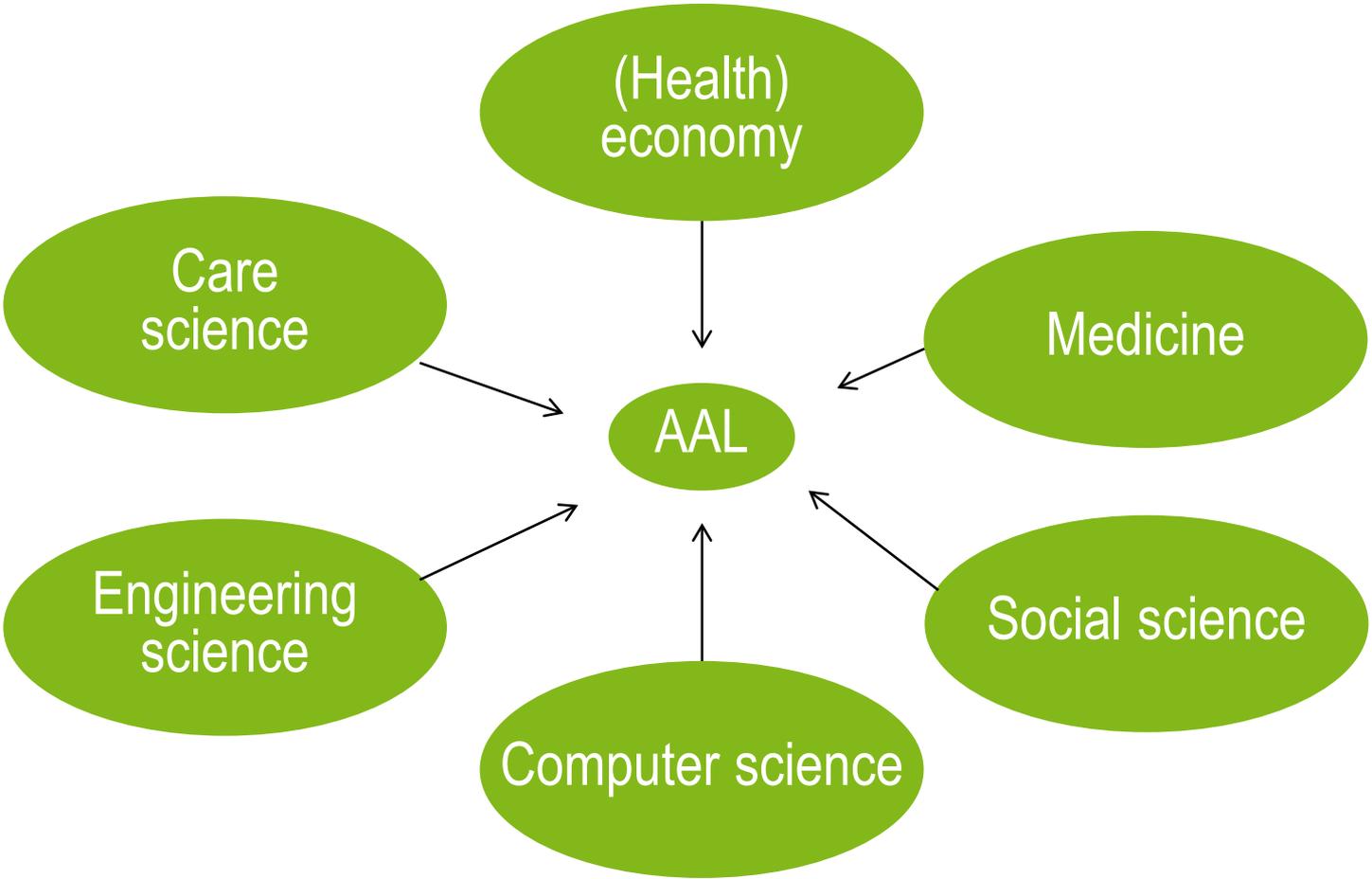


source: ICT enabled independent living for elderly, VDIVDE/-IT, 2010

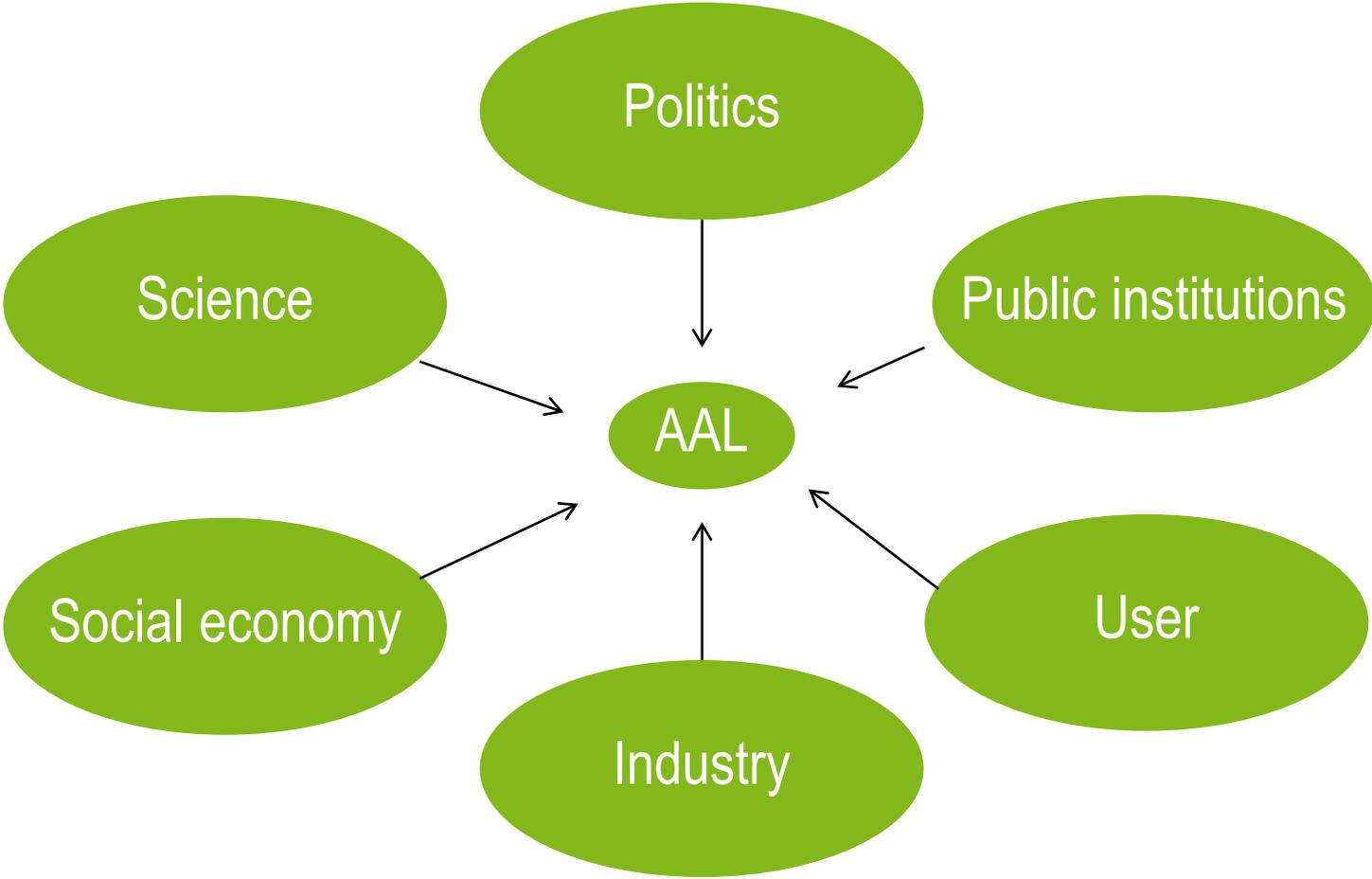
Interdisciplinarity is the interaction of different disciplines, whereby approaches, ways of thinking and methods are exchanged among each other.

- The disciplines have developed their own, long-standing traditions and even "languages".
- Often (especially new) possibilities of one particular discipline are not known to all others.

AAL is an inter-disciplinary application area



AAL is an area with many stakeholders

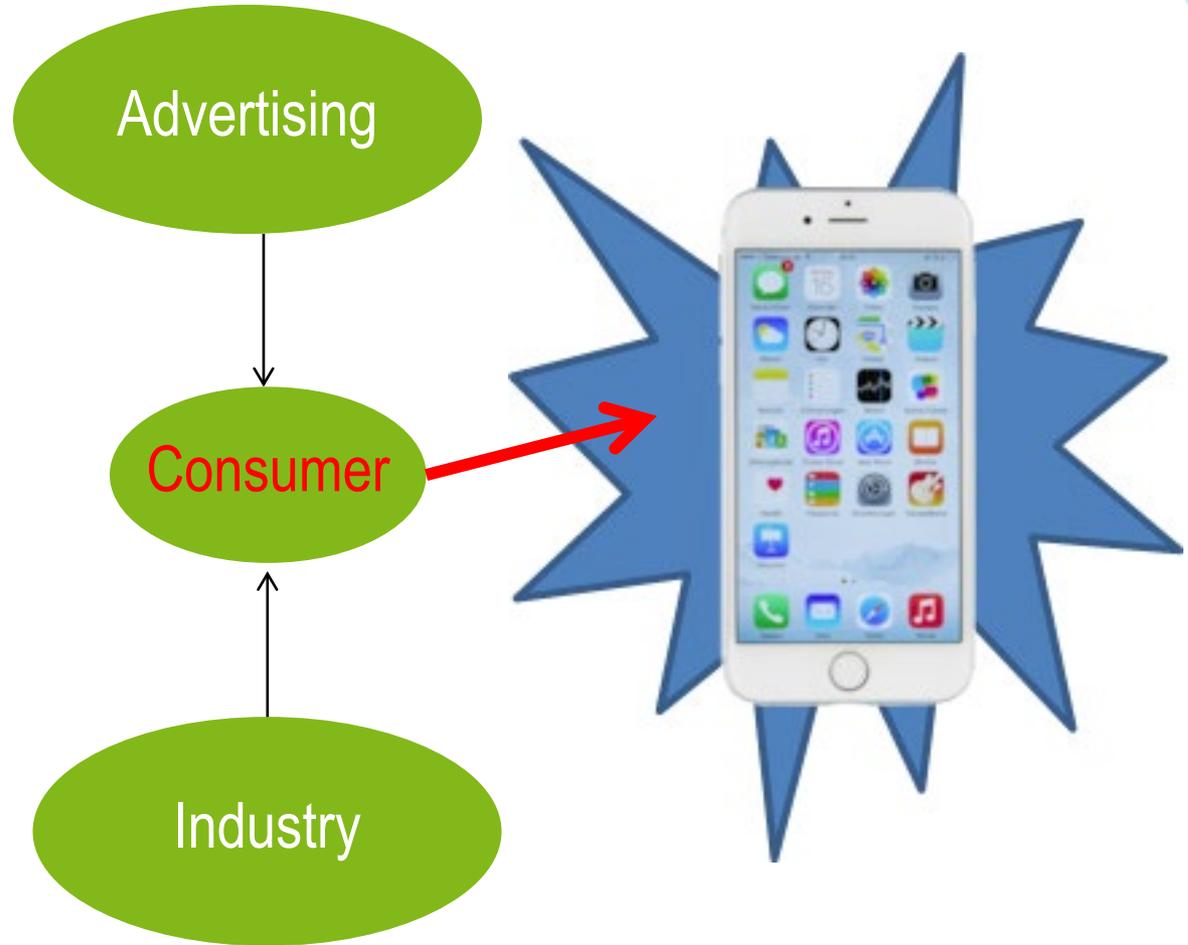


What do the individual areas contribute?

What is missing in the collaboration?

What makes the AAL market special?

Distinction: Consumer Market



Perspective of users

AAL offers possible solutions to existing problems and support and relief in everyday life

AAL is diffuse and elusive, AAL solutions are barely known

AAL solutions are also seen with fears and worries ("dehumanization", cost, control, privacy, ...)

Perspective of medicine

Particularly important are geriatrics (teaching of the diseases of aging people) and in particular gerontopsychiatry (mental illness of the elderly)

The focus is on prevention, diagnosis and therapy (age-related) diseases as well as rehabilitation

Perspective of Nursing Science

The starting point of nursing science is a holistic view of man, in which the perspective and the experience of the well-groomed person play an important role. Behavior and interaction of caregivers and clients.

Effectiveness and quality of nursing measures on the social, emotional and physical aspects of the client.

Fields of work are nursing theories (models for the description of nursing) and nursing research (examination of existing nursing models and processes in terms of quality and efficiency)

What effects do technical assistance systems have on the various aspects of care?

Perspectives of the technical sciences

AAL is from the viewpoint of technology an application field or a market.

Of particular importance for AAL are computer science, information and communication technology, medical technology, building services engineering, microsystems engineering and robotics

Technical sciences are not primarily oriented to knowledge gain, but to problem solving under given framework conditions

Perspectives of Economics (-sciences)

AAL is an application field or a market from the point of view of the economy.

AAL takes place partly in the free market and partly in regulated markets (health care)

AAL solutions typically include a combination of products and services

AAL solutions often require new business models for implementation

Assistive systems in the AAL context

- are a broader integrative approach than aids
- must be open towards medicine and nursing (interfaces)
- have to pay off for society and economy (no consumer market)
- are designed to be active themselves and, in addition to the potential benefits, must also consider the prevention of potential harm
- should be designed to be easy to use and grow with
- have to fit into the living environment
- need support / service at least in the beginning

- AAL as a background for assistive systems is a complex melting pot of influences
- The classic consumer does not actively appear, but the user remains centrally important
- Previous individual solutions were unsuccessful because they were too classically oriented
- The economic potential is huge and growing but not easy to implement
- Assistive systems need to be open to networking (including future ones), which can not be reconciled with proprietary solutions
- In addition to the hardware, it needs a comprehensive service (instead of a new device every 6 months)

Some Systematics:

Basic elements of Assistive Systems

Technical devices, forming Assistive Systems consist of:

- **Sensors:**
 - Sensing environment and presence/activities of user (infrared, temperature, illumination, vibrations, ...)
 - Are an important source of context information and decisions
- **Interoperability:** independent technical devices (e.g. Tablet, TV, movement sensor, fridge, entrance door) shall be able to „communicate“, i.e. there ought to be universal „standard“ interfaces and interpretation of data must be clear (value range, timestamp, etc.)

- **Control software:**
 - Evaluation of sensor signals based on rules,
 - taking decisions,
 - control of actuators
- **User interface**
 - (should be simple despite complexity),
 - fitting to user group.
 - Serves information and control purposes

- **Actuators:**
 - Can actively influence states in the environment (switchable power sockets, light, heating)
 - Can also initiate emergency calls
- **Combinations** of sensors and actuators:
 - Power socket: senses current (sensor) & switches (actuator)
 - Tablet, Smartphone, Smartwatch: Microphone (sensor) & speaker (actuator)

Base principle: **perceive --> decide --> act**

- **Perceive:** Sensor data is processed as basis for context (pre-processing)
- **Decide:** Mostly based on rules and based on the current context a decision (set-actual comparison etc.) is taken
- **Act:** The current state shall be transferred into the desired state or a deviation shall be flagged

Traceability/liability?

=> Logging (problem with some AI)

AAL is more complex than traditional systems

Control software:

Based on the **context information** (situation of the environment and the user), it assesses the state of the environment and decides whether "adjustments" (by control signals to actuators) are necessary.

AAL much more complex than "normal" control.



Simple example – nightly going to toilet

Perceive:

User leaves bed (source: motion sensor)

Room / corridor is dark (source: brightness sensor)

Decide:

The control software knows that it is night; and that it is safer when light is on. It also knows the “normal” duration of a toilet visit.

Act:

Control software activates night light; if user takes too long to return to bed, an alarm is triggered.

But: people behave differently and have different preferences

What can be different from day to day and user to user?

Context information

describes the current state of the system space

- Context information is all information that helps the system to best assess the current situation
- To have as much context information as possible facilitates the assessment/decision
- But unordered masses of data still bring no added value
- Proper selection and preprocessing important
- Sometimes an automated system recognizes patterns without pre-defined rules (self-learning)

Obtaining contextual information:

- **Sensors** (= external from the perspective of the control software)
- **Internal state** management e.g. if "light off" command was sent and it is night, the system knows it should be (most likely) dark now
- **Logical reasoning** ("inference"): e.g. if high humidity in the bath it was / is (probably) showered / bathed
- **User activity on user interface** (direct commands but is also a kind of sensor)

User Interface

- AS are complex systems consisting of many different components with many different functions.
- Complex question: how can the user get access to all the functions in an intuitive, simple manner?

Often the AS offers the user several ways of interaction via the user interface, e.g. control by gestures, touchscreen (GUI), voice recognition

Also combined use of more than one interaction form/modes (e.g. pointing gesture on device and voice command „switch on“) is possible
(→ **multimodal interaction**) and helpful also to offer alternatives

Different interaction types:

- **„explicit interaction“** is the conscious control of the system, e.g. by hand gesture „Radio on“, by GUI / Touchscreen, by voice command, by button...
- **„implicit interaction“** controls the system by behaviour, which does not require concrete attention of the user , e.g. entering a room or sitting down on a chair

- Is it really beneficial to have access to all possible functionalities at all times?
 - Or is it better to restrict access to a smaller number of functions (cf. Apple)?
 - Goal: simplification of use, avoid errors.
- **„intention based interaction“**: the system learns/estimates which functions the user could need in a specific situation and hides the rest or actively proposes a function
 - Disappearing functions might be confusing

„goal based interaction“:

the user doesn't activate a specific function of a single device („coffee machine on“) but formulates a goal, which the assistive system shall achieve („I like to have breakfast with coffee in 5 minutes “)

Assistive Systems consist of

- technical devices („**networked devices**“),
- spread over some area („**system space**“) and
- together as network they form the **system**,
- which **supports** the user in **meaningful** way

Different common terms:

- Smart Environments
- Assistive Systems
- Ambient Intelligence (Aml)-Systems
- Ambient Assisted Living (AAL)-Systems

- **system space** can e.g. mean one's flat
- It grows, if linked technical devices are used outside home (Mobility).
- In general an assistive system will not support all functions always and over all the system space
 - If restrooms or bedrooms are not equipped with cameras, then the gesture control won't work there.
 - same for microphones / voice commands
 - Mobile use might be restricted in functionality by limited power budget

Outlook, following lectures:

- II Active user interfaces (HCI)
- III Assistive Robotics
- IV Sensors
- V Ethics and law, economy
- VI Requirement analysis and evaluation

Background for AAL:

Active and Assisted Living Programme - ICT for ageing well

<http://www.aal-europe.eu/>

AAL AUSTRIA - Innovationsplattform für intelligente Assistenz im Alltag

<http://www.aal.at/>

FFG / BMVIT benefit

<https://www.ffg.at/benefit>

BMVIT Active and Assisted Living (AAL) Research and Development Programme

<https://www.bmvit.gv.at/en/innovation/ict/aal.html>

Altersgerechte Assistenzsysteme als Hilfe für künftiges Wohnen und sicheres Leben

<http://nullbarriere.de/aal-altersgerechte-assistenzsysteme.htm>

Studie Unterstützung Pflegebedürftiger durch technische Assistenzsysteme

<http://www.vdivde-it.de/publikationen/studien/unterstuetzung-pflegebeduerftiger-durch-technische-assistenzsysteme>

AAL	Active and Assisted Living / Ambient Assisted Living
AI	Artificial Intelligence
Aml	Ambient Intelligence
AS	Assistive System
AT	Assistive Technology
ICT	Information and Communication Technology
KI	Künstliche Intelligenz
HCI	Human Computer Interaction
RT	Rehabilitation Technology