WORKINGAGE

Smart Working Environments for All Ages

D10.3 Report with Lessons Learnt from Other Projects

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WP10 – Dissemination, Exploitation Strategy and Value Chain Modelling

D10.3 Report with Lessons Learnt from Other Projects

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Executive Summary

A study on other research & innovation projects that treat topics related to WorkingAge is presented. The goal is to identify synergies in terms of specific comparable research topics, e.g. related to occupational health or sensor technology.

This document is meant to be a practical reference document for the consortium. Therefore a research methodology is used based on a definition of principal features and focus areas of WorkingAge, so that possible synergies can be clearly indicated in tables. This is completed with brief easy-to-read assessments per project.

The projects are grouped in 3 chapters:

1. On-going projects responding to the same call as WorkingAge,
2. Other on-going projects from different calls,
3. Finalised projects.

These groups are at different project-lifetime stages that facilitate different kinds of collaboration, e.g. based on results or technology.

Several projects are identified to close to WorkingAge's activities and goals, with these the potential for fruitful collaboration is the highest. Ageing@Work and sustAGE are identified for their similar concept of pilot studies. Other projects are interesting for specific technologies, such as SmartWork for cardio- and brain sensors, Nevermind on personalised Human Machine Interfaces and Satisfactory for localisation and gesture interfaces.

For deploying the potential synergies, the first steps of collaboration will be in dissemination and communication activities, paving the way for other opportunities on e.g. technical matters or privacy handling.

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1 Introduction

This document presents the study of other research & innovation projects that treat topics related to WorkingAge. It builds on the initial study included in the Description of the Action (DoA) of the project, section 1.3.

The goal is to identify synergies in terms of specific comparable research topics, e.g. related to occupational health or sensor technology. Other more generic possibilities of collaboration exist and will be considered too, like joint communication, dissemination activities, and privacy handling including the implementation of the European General Data Protection Regulation (GDPR). Since these are very similar for each project, they are not specifically mentioned for each project.

2 Research methodology

The goal of this document is to be a practical reference document for the consortium. To this end, a set of principal features and focus areas of WorkingAge are defined, so that possible research areas are identified linked to the research in other projects and used to explore synergies.

In order to use the project's time and budget wisely, it was decided to concentrate the study on Horizon 2020 and FP7 projects. A brief look into other projects (using resources from e.g. Expert Advisory Board member EU-OSHA[1] and EuroHealthNet[2]) lead to the conclusion that outside the European Commision's research and innovation framework programmes no significantly different topics were addressed.

For each listed project the Cordis[3] description is given, followed by the aforementioned comparative table and a brief easy-to-read assessment. This method of determining features replaces the Work Package(WP)-based approach proposed in the DoA, as the WPs are used to define a work plan and may address multiple research topics of the project.

The assessed projects are grouped in three categories:

1. On-going projects from the same call (chapter 3). As these projects respond to the same call, they are greatly comparable to WorkingAge, aiming at facilitating people to keep working at higher ages. The assessment can therefore include detailed features; described below in this section. These projects cover largely the same period of time which

[1] https://osha.europa.eu/en

[2] http://www.healthyageing.eu/sites/www.healthyageing.eu/files/featured/Healthy%20and%20Active%20Ageing.pdf

[3] https://cordis.europa.eu/

facilitates collaboration throughout the projects' lifetimes: for instance initially for technological solutions, later on joint dissemination of results.

2. Other on-going projects (chapter 4). The research areas and objectives of these projects are more diverse, and therefore features and focus areas are of a more generic nature. See the list below. Some of these projects are close to their end and therefore collaboration can focus a bit more on the use of results.
3. Concluded projects (chapter 5). The set of features and focus areas are the same as in chapter 4. Collaboration would be focused mainly on project results, however may result more difficult as they are beyond their funded period.

The goals of projects from the same call largely overlap because they respond to the same demand; therefore the comparison focuses on applied technology for interfaces and sensors. At the moment of writing of this document, a list of candidate sensor technologies is available in deliverable D2.1. Even if eventually not all these sensors are included in the WorkingAge Tool, this list gives good insight of possible synergies.

- WA main human-computer interface characteristics:
  1. Mobile interface - a mobile device as main user interface
  2. Virtual assistant - a friendly avatar communicates with the user
  3. VR/AR - virtual and/or augmented reality interface
  4. Gestures - the user can send commands using gestures
  5. Voice - spoken interaction with the virtual assistant
  6. 112 - possibility to contact 112 emergency services
  7. Platform - data interface with the enterprise's IT systems

- WA main sensor technologies:
  1. ECG - electrocardiogram, electrical heart activity
  2. EEG - electroencephalogram, electrical brain activity
  3. EMG - electromyography, electrical muscle activity
  4. GSR - galvanic skin response, sweating indicator
  5. Gestures - arm/body movements
  6. Facial expression - recognition of affective states
  7. Voice analysis - voice emotion recognition
  8. EOG - electrooculography, several eye movements
  9. Eye movement - visual technology for measuring eye movements
  10. Pupil diameter - visual technology for measuring eye movements
  11. Ext. networks - integration of social, working and health services
  12. Body pose - visual recognition of body postures
  13. Noise - environmental noise
  14. Vibration - vibration measurement
  15. Thermohygrometric - temperature and humidity
  16. Pollutants - CO_2 and possible other pollutants
  17. Illumination - amount of light at the work place
  18. Location - indoor and outdoor position determination

For the projects from different calls, both on-going and finalised, the project features are on a more general level.

- WA main characteristics and focus:
  1. Wellbeing for those aged 50+
     - The project focuses on improving life of people at age, regardless of the environment they are in (e.g. working, domestic). Note that the age range for WorkingAge is set to 50+, some other projects apply different thresholds.
  2. At working environments
     - The project focuses on improving working environments, regardless of age
  3. Mental parameters
     - Mental states of people are investigated
  4. Physical parameters
     - Physical states of people are investigated
  5. Measure people's environment
     - Environmental characteristics of users are measured and analysed
  6. Real-time feedback through friendly GUI
     - The user is informed near real-time through a friendly screen interface
  7. Integration in enterprise systems
     - The proposed solution connects to company IT systems
  8. Product enterprise market
     - The project envisages putting a product on the market with companies as clients

3 On-going projects from the same call

3.1 See Far

Smart glasses for multifacEted visual loss mitigation and chronic disEase prevention indicator for healthier, saFer, and more productive workplAce foR ageing population

Horizon 2020 – 01/12/2018 – 30/11/2021

www.see-far.eu

Description

See Far project aims to develop and validate a digitally enabled adaptive solution supporting ageing workforce with vision loss, an age-related condition, to remain actively involved in professional life, helping them to sustain and renew their work and personal life related skills and support independent active and healthy lifestyles. The See Far solution consists of two components: (i) See Far smart glasses where the display lenses are adapted to the needs of the

users and optimize their view. In order this to be achieved a personalized visual assistant is developed capturing the condition of the eye, detecting the problem and provide the appropriate adjustment through the integration of augmented reality technologies. See Far smart glasses empower older adults to solve the most meaningful problems, transform how they design, build, maintain and collaborate in their organization, perceive the world conveniently and enjoy a safer exploration in an indoor/outdoor environment. (ii) See Far mobile application allowing monitoring of the central vision evolution and prediction of the risk for the presence of diseases (i.e. diabetes risk, cardiovascular risk). It will capture retinal images, through a digital direct ophthalmoscope attached in the smartphone, analyse the images (Image Analysis Component), and detect the type and the stage of vision impairment (Decision Support Component). The combination of the output of the See Far mobile application (indicator of the presence of a visual or not problem) with the output of the See Far smart glasses (type of daily visual issues the user has and his/her behaviour) will lead to the provision of suggestions, through augmented reality, to the user supporting independent active and healthy lifestyles. The suggestions will be adaptive to the profile of the user through the Personalised visual recommendation service.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
x	x	x				

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
								x	x								

Other sensors in this project:

- Smart glasses
- Ophthalmoscope

See Far focuses largely on smart glasses and eye analyses, Smart glasses are not used in WorkingAge (AR will most likely be on a screen), but some measurements concerning the eye will be done (EOG, eye movement, pupil

diameter). Interaction with the experts on eye studies of See Far can be useful for WorkingAge.

3.2 Ageing@Work

Smart, Personalized and Adaptive ICT Solutions for Active, Healthy and Productive Ageing with enhanced Workability

Horizon 2020 – 01/01/2019 – 31/12/2022

ageingatwork-project.eu

Description

Ageing@Work will develop a novel ICT-based, personalized system to support ageing workers (aged 50+) into designing fit-for-purpose work environments and managing flexibly their evolving needs. Advanced dynamically adapted virtual models of workers will incorporate specificities in respect to skills, physical, cognitive and behavioural factors, being extended from the work context to personal life aspects interacting with workability, health and well-being. Virtual workplace models will encode characteristics of the workplace (factory, outdoor work site, home), at both physical and semantic, resource/process levels. On top of the models, computational intelligence will be responsible to (a) assess user specificities and needs i.r.t. work conditions, both in terms of ergonomics, health and safety issues and task assignments, and (b) perform personalized predictive simulations on workability, health and well-being. Recommendations will then be provided both to the worker and company (under strict privacy restrictions), on how the working conditions must adapt. The worker models will be populated by highly unobtrusive worker sensing, both at work, at home and on the move. To foster workability and productivity, highly personalized, intuitive, age-friendly productivity, co-design enhancement tools will be developed, including ones for AR/VR-based context-awareness and telepresence, lifelong learning and knowledge sharing. On top of these, a novel Ambient Virtual Coach (AVC) will encompass an empathic mirroring avatar for subtle notifications provision, an adaptive Visual Analytics – based personal dashboard, and a reward-based motivation system targeting positive and balanced worker behaviour at work and personal life, towards a novel paradigm of ambient support into workability and well-being. The integrated system will be developed by user-centred design and will be evaluated at two pilot sites, related to core Industry 4.0 processes of mining and machines production.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
x	x	x				

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
										x							

Interesting for WorkingAge is the coincidence with factory pilots, and the planned virtual factory workplace model. No clear information is available at the moment about what sensors will be used for the "highly unobtrusive worker sensing". The Ageing@Work behavioural modelling of the workers, including cognitive and ergonomic aspects, will be very interesting to follow and discuss for WorkingAge.

3.3 BIONIC

Personalised Body Sensor Networks with Built-In Intelligence for Real-Time Risk Assessment and Coaching of Ageing workers, in all types of working and living environments

Horizon 2020 – 01/01/2019 – 31/12/2022

bionic-h2020.eu

Description

The overall objective is to develop a holistic, unobtrusive, autonomous and privacy preserving platform for real-time risk alerting and continuous coaching, enabling the design of workplace interventions adapted to the needs and fitness levels of specific ageing workforce. Gamification strategies adapted to the needs and wishes of the elderly workers will ensure optimal engagement for prevention and self-management of musculoskeletal health in any working/living environment. The BIONIC concept will be a game changer in medical wearable technology integrating sensor modules in multi-purpose, configurable Body Sensor Networks (BSNs) introducing key enablers of user acceptance based on value, comfort, confidence and trust. BIONIC consists of a multidisciplinary team of researchers in the field of Wearable Electronics (IAW), Artificial Intelligence, Wearables for Health applications, and experts in Ergonomics and Anthropometry, Occupational Safety and Health, Data Analytics and System Security and Personal Data Protection. Results will be validated n real workplace environments by two prominent European Enterprises from the Construction and the Manufacturing sectors.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform		
x								

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
											x						

Both BIONIC and WA measure the body pose of the user. The BIONIC project makes use of IMUs (Inertial Measurement Unit, a movement sensor) attached to the clothes of the user, whereas the WorkingAge use cameras located in the environment. The comparison of both methods with regard to accuracy, cost, etc. could be interesting for both projects

3.4 CO-ADAPT

CO-ADAPT: Adaptive Environments and Conversational Agent Based approaches for Healthy Ageing and Work Ability

Horizon 2020 – 01/12/2018 – 31/05/2022

coadapt-project.eu

Description

Active ageing along with work ability frameworks contributed mostly to inform policies and development of research methods rather than concrete solutions such as technologies and applications. Ageing citizens face particular difficulties in remaining active if having reduced capabilities due to age-related conditions and challenges posed by knowledge digitalization, the accessibility of digital channels, digital interfaces and digital socialization. CO-ADAPT proposes a framework that provides principles for a two-way adaptation in support of ageing citizens. 1) Human Adaptation Support: CO-ADAPT empowers ageing citizen to adapt to changed conditions through a personalised Artificial Intelligence (AI) conversational agent providing comprehensive change support based on language and physiological analytics. 2) Work Systems Adaptations: CO-ADAPT defines three types of smart

adaptations in work systems with different level of technology sophistication to age thresholds in smart shift scheduling tools, to individual capabilities considering cognitive workload in assembly stations, adaptations to work tasks in contextually recommending people, documents and applications for cognitive augmentation. The evaluation approach is focussed on quantifying economic benefits in terms of improved work ability. It includes a comparative trial of the Human Adaptation Support, the personalised conversational agent application, in north and south Europe for investigating cultural applicability. The Work Systems Adaptations are trialled in real environments with an extensive pilot for the smart shift scheduling tools in Finland (N=20 000), and more focused trials with sophisticated prototypes for the assembly station adaptations in Italy and contextual entity recommender in Finland. The consortium includes comprehensively stakeholders and disciplines geared for a participatory design approach, compliance with ethical and data directives, and effective exploitation of results.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
	x			x		

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location

The virtual assistant of CO-ADAPT is a conversational agent, overlaps with WorkingAge and interchange of experiences could be useful. Both projects have a strong AI component, but since the applications are quite different it is not clear at this point if synergies exist. CO-ADAPT measures wellbeing (e.g. sleep, absence) but no sensor overlap exists with WorkingAge.

3.5 SmartWork

Smart Age-friendly Living and Working Environment

Horizon 01/01/2019 – 31/12/2022

smartworkproject.eu

Description

The design and realization of age-friendly living and working environments is a huge challenge that we have just only started to address as the number of older citizens who are and want to continue being active members of society and live independently is constantly increasing. SmartWork builds a worker-centric AI system for work ability sustainability, integrating unobtrusive sensing and modelling of the worker state with a suite of novel services for context and worker-aware adaptive work support. The unobtrusive and pervasive monitoring of health, behaviour, cognitive and emotional status of the worker enables the functional and cognitive decline risk assessment. The holistic approach for work ability modelling captures the attitudes and abilities of the ageing worker and enables decision support for personalized interventions for maintenance/improvement of the work ability. The evolving work requirements are translated into required abilities and capabilities, and the adaptive work environment supports the older office worker with optimized services for on-the-fly work flexibility coordination, seamless transfer of the work environment between different devices and different environments (home, office, on the move), and on-demand personalized training. The SmartWork services and modules also empower the employer with AI decision support tools for efficient task completion and work team optimization through flexible work practices. Optimization of team formation, driven by the semantic modelling of the work tasks, along with training needs prioritization at team level to identify unmet needs, allow employers to optimize tasks (e.g. needed resources), shifting focus on increased job satisfaction for increased productivity. Formal and informal carers are able to continuously monitor the overall health status and risks of the people they care for, thus providing full support to the older office worker for sustainable, active and healthy ageing.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
x						

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
x	x													x	x	x	

The SmartWork project tries to assess and support active and healthy ageing people at work and home environments. While WorkingAge focuses more on working environments while developing specific sensors for very rich user data, generic (commercial) sensors are used in SmartWork which are less accessible and controllable, also because of the heterogeneous home environments. Comparison of results could give interesting insights, e.g. the added value of developed sensors, stability, final costs for end-users.

3.6 sustAGE

Smart environments for person-centred sustainable work and well-being

Horizon 01/01/2019 – 31/12/2021

sustage.eu

Description

sustAGE aims to develop a person-centred solution for promoting the concept of "sustainable work" for EU industries.

The project provides a paradigm shift in human machine interaction, building upon seven strategic technology trends, IoT, Machine learning, micro-moments, temporal reasoning, recommender systems, data analytics and gamification to deliver a composite system integrated with the daily activities at work and outside, to support employers and ageing employees to jointly increase well-being, wellness at work and productivity. The manifold contribution focuses on the support of the employment and later retirement of older adults from work and the optimization of the workforce management. The sustAGE platform guides workers on work-related tasks, recommends personalized cognitive and physical training activities with emphasis on game and social aspects, delivers warnings regarding occupational risks and cares for their proper positioning in work tasks that will maximize team performance.

By combining a broad range of the innovation chain activities namely, technology R&D, demonstration, prototyping, pilots, and extensive validation, the project aims to explore how health and safety at work, continuous training and proper workforce management can prolong older workers' competitiveness at work. The deployment of the proposed technologies in two critical industrial sectors and their extensive evaluation will lead to a ground-

breaking contribution that will improve the performance and quality of life at work and beyond for many ageing adult workers.

Possible synergies

Human Computer Interface

Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
x						

Sensors

ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
												x		x	x		x

Both sustAGE and WorkingAge pay attention to the communication with the users. Both projects will be able to do personalized recommendations in order to improve the physical and mental health of the workers. Pilots are in manufacturing and transport, both present in WorkingAge.

4 Other on-going projects

4.1 NESTORE

Novel Empowering Solutions and Technologies for Older people to Retain Everyday life activities

Horizon 2020 – 01/09/2017 – 31/08/2020

nestore-coach.eu

Description

Ageing population is growing faster in EU. ICT can provide solutions for Active Ageing, however the success of novel ICT solutions depends on the user perception about their efficacy to support toward health promotion and global wellness.

NESTORE will develop an innovative, multi-dimensional, personalized coaching system to support healthy ageing by: 1) Generating and sustaining motivation to take care of health; 2) Suggesting healthy nutrition and personalized physical

and mental coach, as well as social interaction, to prevent decline and preserve wellbeing.

The main concept is to develop NESTORE as a friend and a coach able to support both the individual and the social dimension. The friend NESTORE understands the emotional status of the user; the coach NESTORE understands the "weaknesses" of the user and proposes actions and activities that improve and maintain wellbeing. Key innovation element in NESTORE is the design of "pathways of interest" able to provide hints and services according to the user's preferences, while ensuring that the overall wellbeing and health status is maximised.

NESTORE leverages on novel ICT technologies: 1) multi-domain unobtrusive monitoring system, including wearable and environmental sensors and tangible objects, 2) intelligent Decision Support System, to analyse the seniors' behaviour and provide personalized targets toward wellbeing 3) active coaching, developed as conversational agent, embodied in a physical companion that assumes different forms, able to establish affective communication through multimodal communication channels and to engage older people with personalized coaching activities in a single or multiple domains.

Methodological strengths of our approach are: 1) co-design research adopted throughout the project 2) thorough system validation with respect to usability, acceptability and effectiveness 3) development of a sustainable ecosystem involving citizens and stakeholders for the co-production of wellness.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x			x	x	x		

Both projects use biosensors to measure the subject's actual physical condition and provide feedback through a user-friendly interface on a mobile device. NESTORE doesn't focus on professional life and enterprises, and adds nutritional monitoring.

Coordinated by WorkingAge's partner POLIMI.

4.2 CAPTAIN

Coach Assistant via Projected and Tangible Interface

Horizon 2020 – 01/12/2017 – 30/11/2020

www.captain-eu.org

Description

Older adults typically prefer living at their homes as long as possible. However, they often need to be institutionalized due to the age related problems.

Homecare can benefit today from a range of existing technologies including smartphones, sensors, etc., however, their effectiveness is limited by the sense of fear and uncomfortableness that many older adults feel. Most current technologies, in fact, are often not designed for older adults, least of all for users with memory impairments. The derivative limitations become a major barrier, severely limiting use of technological assistance in a home environment. CAPTAIN proposes a "transparent" technology designed to turn the home of the older adult into a ubiquitous assistant specifically designed to compensate for their physical and memory impairments during their daily living. To do so, it leverages on a few state-of-the-art technologies, as follows: "Projected augmented reality" to project, through use of micro-projectors, contextualised (directly on walls, floor, tables, etc.) information and instructions on top of the real environment. Real-time 3D sensing technologies to comprehend the "indoor space" (nature and position of objects and actions of the persons) and to allow transforming it into a ubiquitous tangible interface. 3D sensing, together with speech analysis, will allow device-free comprehension of the environment and of the behaviour of the adults (including its changes). Non-invasive physiological and emotional data analysis from facial micro-expressions and human body pose thanks to scalable, robust, and accurate deep learning and artificial intelligence. The coach will leverage on a motivational engine to promote correct nutrition, physical activity, cognitive and physical training, risk avoidance, and social participation. To achieve this CAPTAIN will foster a truly user-centred co-design philosophy - based on constant involvement of older adults in the design, development, and testing stages.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x		x	x	x	x		

Both projects aim to improve the well-being of elderly; however CAPTAIN focuses more on people at a later stage of life, retired people at home. There is overlap in the data collection techniques (e.g. facial expressions, body pose); it could be interesting to exchange experiences.

4.3 EMPATHIC

Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly

Horizon 2020 – 01/11/2017 – 31/10/2020

http://www.empathic-project.eu

Description

The EMPATHIC Research & Innovation project will research, innovate, explore and validate new paradigms and platforms, laying the foundation for future generations of Personalised Virtual Coaches to assist elderly people living independently at and around their home.

Innovative multimodal face analytics, adaptive spoken dialogue systems and natural language interfaces are part of what the project will research and innovate, in order to help dependent aging persons and their careers.

The project will use remote non-intrusive technologies to extract physiological markers of emotional states in real-time for online adaptive responses of the coach, and advance holistic modelling of behavioural, computational, physical and social aspects of a personalised expressive virtual coach. It will develop causal models of coach-user interactional exchanges that engage elders in emotionally believable interactions keeping off loneliness, sustaining health status, enhancing quality of life and simplifying access to future telecare services.

The project will include a demonstration and validation phase with clearly-defined realistic use cases. It will focus on evidence-based, user-validated research and integration of intelligent user and context sensing methods through voice, eye and facial analysis, intelligent heuristics (complex interaction, user intention detection, distraction estimation, system decision), visual and spoken dialogue system, and system reaction capabilities.

Through measurable end-user validation, to be performed in 3 different countries (Spain, Norway and France) with 3 distinct languages and cultures (plus English for R&D), the proposed methods and solutions will ensure usefulness, reliability, flexibility and robustness.

The project partners include health-maintenance end-user organisations, technology developers, academic / research institutes and system integrators.

The project, planned for a 36-month duration, is estimated to require total funding of 4 M€.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x		x	x	x	x		

As with CAPTAIN, the EMPATHIC project focuses much on elderly people at home, though the Virtual Coach is said to be applicable also at work. Both facial characteristics and speech analyses are used to determine emotional states, as in WorkingAge.

4.4 INCLUSIVE

Smart and adaptive interfaces for INCLUSIVE work environment

Horizon 2020 – 01/10/2016 – 30/09/2019

inclusive-project.eu

Description

The market demands flexible productions lead to complexification of production systems and hence to more articulated Human Machine Interface (HMI). This new features tend to exclude from working environment elderly people who, even if they have a great experience, feel uncomfortable in the interaction with a complex computerized system. Moreover, complex HMI creates a barrier to young inexperienced or disabled people for an effective management of the production lines. To tackle these problems INCLUSIVE aims to develop a new concept of interaction between the user and the machines, in which the behaviour of the automation system adapts to human operator capabilities. Hence, INCLUSIVE develops an ecosystem of technological innovations driven by human factors analysis applied to three concrete industrial use cases, carefully chosen to represent a wide range of needs and requests from industry.

INCLUSIVE is based on three pillars:

- Human capabilities measurement.
- Adaptation of interfaces to human capabilities.
- Teaching and training the unskilled users.

Once developed, the new system will be initially tested in lab and then in the use case premises where cognitive load measurement data will be analysed. 12 months of the project are dedicated to the adoption and use in real conditions of the new tools in the three industrial use cases, in order to demonstrate its validity and improvement reached in working environment.

The anonymity of workers will be completed guarantee and the data collected will not be attributable to a specific person.

The consortium is formed by eleven partners (six companies and 5 research centres) located in Germany, Greece, Italy, Poland and Turkey, which represent a full product value chain that include: HMI developer (PROGEA), software developer (SOFTFACT) machine developer (KHS, SCM), system integrator (GIZELIS), final user (SILVERLINE) and research centres (UNIMORE, TUM, RWTHA and CIOP), and a technology transfer specialist (ASTER).

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
	x	x	x				

The INCLUSIVE project assesses the worker state, by measuring both mental and physical data, in order to determine for example stress. Both INCLUSIVE and WorkingAge make use of an eye tracker device to measure the worker state. Comparisons of obtaining and interpreting mental data can be insightful. This includes aspects as having people wear intrusive sensors, and handling of private data (GDPR).

4.5 MANUWORK

Balancing Human and Automation Levels for the Manufacturing Workplaces of the Future

Horizon 2020 – 01/10/2016 – 31/03/2020

manuwork.eu

Future manufacturing will be characterized by the complementarity between humans and automation, especially regarding the production of highly customizable products. This requires new methods and tools for the design and operation of optimized manufacturing workplaces in terms of ergonomics, safety, efficiency, complexity management and work satisfaction. MANUWORK aims to focus on the development of an integrated platform for the management of manufacturing workplaces of the future. This will be done through development, implementation and testing of the following technological components:

1. A tool for determining optimal human-automation levels for load balancing, based on methods for the assessment of physical, sensorial and cognitive capabilities of humans, the prediction of evolution of human skills/capabilities using Petri Nets and the modelling of automation skills.

2. A framework for the evaluation of worker satisfaction, safety and health, based on methods for evaluating psychometrics and socio-organizational parameters and the safe human-automation symbiosis.

3. A framework for the adaptive shop-floor support and industrial social networking based on an Augmented Reality tool for the Human-Automation Interface, an industrial social networking platform and methods for knowledge capturing and social analytics.

A critical target will be the active and passive use of information from workers, without storing any personal data, in order to maintain the confidentiality of the person involved. This will be done through the direct use of data for the calculation of factors of workplace models for the dynamic assignment of workers based on the groups they belong to (e.g. age group). Finally, MANUWORK will test and validate the research and technological developments in three industrial pilot demonstrators (aerospace, automotive

and people with disabilities), following an industrial pre-pilot validation (machine tool sector).

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User' environmt	RT info GUI	Enterprise system	Product enterprise
	x		x		x	x	

Manufacturing work places are the core of Manuwork, and one of the three pilot use cases of WorkingAge. Both projects place sensors and AR interfaces at the work place.

The partners of the Manuwork project pay particular attention to the worker privacy regarding data collecting. This is also a priority of the WorkingAge consortium. The data collected during the project will be anonymised for their use and storage.

4.6 NEVERMIND

NEurobehavioural predictiVE and peRsonalised Modelling of depressIve symptoms duriNg primary somatic Diseases with ICT-enabled self-management procedures

Horizon 2020 – 01/01/2016 – 31/12/2019

nevermindproject.eu

Personal health systems for the management of chronic diseases have seen giant leaps in development over recent years. These systems offer vital sign monitoring and therapy delivery at home, focusing on the primary physical disease conditions. However, they do not provide support for early mood assessment or psychological treatment and lack a real-time comprehensive assessment of the patient's mental status.

Depression is the third leading contributor to global diseases, and depressive mood state is also considered to be strictly related to the onset or worsening of a severe primary somatic disease. Indeed effective preventive medicine related to the onset of depressive symptoms as comorbidity and worsening factor of psychosomatic diseases such as myocardial infarction, leg-amputation, cancer, and kidney failure is lacking.

NEVERMIND sets out to empower people who suffer from symptoms of depression related to a serious somatic disease by placing them at the centre of their mental healthcare. Equipped with just a smartphone and a lightweight sensitised shirt, patients seeking care and treatment for their mental illnesses interact with these devices that collect data about their mental and physical health, to then get effective feedback. Lifestyle factors, i.e. diet, physical

activity and sleep hygiene, play a significant mediating role in the development, progression and treatment of depression, and in NEVERMIND will be monitored by a real-time Decision Support System running locally on the patient's smartphone, predicting the severity and onset of depressive symptoms, by processing physiological data, body movement, speech, and the recurrence of social interactions. The data will trigger a response encouraging the patient to conduct or alter activities or lifestyle to reduce the occurrence and severity of depressive symptoms.

The final aim is to bring this system to the market, giving people the tools to control their depression and unburden their minds.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
		x	x		x		x

As WorkingAge, the project NEVERMIND obtains mainly data from the users by means of two methods. Firstly, wearable sensors are used for measuring physical data such as heart rate, breathing rate, movement patterns, etc. and, on the other hand, other data like diet are collected by means of questionnaires and forms.

5 Concluded Projects

5.1 PERSSILAA

PERsonalised ICT Supported Service for Independent Living and Active Ageing

FP7 – 01/11/2013 – 31/10/2016

www.perssilaa.eu

Description

PERSSILAA aims at the development and validation of a new service model that addresses frailty in community dwelling for older adults. PERSSILAA's main focus is to:

- develop remote service modules for screening, monitoring and training.
- enable a transition of our care services from fragmented reactive disease management to preventive personalized services, that are offered locally, supported by proactive caregivers and health professionals, which is integrated into existing healthcare services.
- set up a technical service infrastructure to support these multiple services and users in an efficient, reliable and easy way which will entail gamification, interoperability and clinical decision support.

The validation will be done in two regions: the Enschede region in the Netherlands and the Campania region in Italy. PERSSILAA builds on activities within the European Innovation Partnership on Active and Healthy Aging and on the results of earlier European projects. The consortium with 8 partners from 5 countries provides a unique mix of social, medical and technological sciences with industry, academia and end user organisations.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x					x		x

Interesting for WorkingAge is the integration of data into one central platform that the users can consult, and do a self-check. Also, the exploitation in which the Dutch Twente University spin-off and scale-up "LangGezond.nl" was involved to make the service available to all Dutch elderly. The portal "LangGezond.nl" evolved into "www.telerevalidatie.nl".

5.2 CAREGIVERSPRO-MMD

Self-management interventions and mutual assistance community services, helping patients with dementia and caregivers connect with others for evaluation, support and inspiration to improve the care experience.

H2020 – 01/01/2016 – 30/04/2019

caregiversprommd-project.eu

Description

According to the World Health Organisation (WHO, ADI), 44 million people around the world have some form of dementia, for which there is no effective intervention, to halt or reverse the progressive cognitive impairment. As Europe's population is ageing, long-term care for elderly citizens will become an increasing cost for society. To manage this transition healthcare policies in the EU and individual Member States are heavily focussed on extending the independent life of the elderly, with the dual aim of increasing their quality of life and reducing the costs of care.

In this project, we will build a mHealth application that is specifically targeted to caregivers and patients with mild to moderate dementia. The result is CAREGIVERSPRO-MMD: a tool integrating a broader diagnostic approach, incorporating the live-in family caregiver-patient dyad and considering this dyad as the unit of care.

CAREGIVERSPRO-MMD will provide value-added services based on social

networks, tailored interventions, clinical strategies and gamification for improving quality of life for dementia's patients and caregivers that allow them to live in the community for as long as possible.

The project will comprise three phases: first, we will develop new services for patients with mild to moderate dementia and their respective caregivers to an existing application.

In the second phase, we will conduct a user-centric analysis to re-design the existing application for patients with mild to moderate dementia. The development will be steered by patients, carers and doctors, through user-centric design: we will collect feedback on each new version of the application until the design is adapted to the users' needs.

In the third phase, we will pilot the optimised application with 550 dyads (patients and their respective caregivers) and 550 controls. This will show the clinical and social benefits for patients and caregivers, as well as financial benefits for the healthcare system.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x					x	x	

As WorkingAge project, CAREGIVERSPRO-MMD project tries to reduce the effects of the ageing of the EU population. Both projects try to enlarge the capabilities and independence of the elderly people. Both projects make use of warnings and advise to change the behaviour of the people in order to improve the quality of life of the people.

5.3 UNCAP

Ubiquitous iNteroperable Care for Ageing People

H2020– 01/01/2015 – 31/12/2017

uncap.eu

Description

The lack of ICT platforms based on open standards is regarded as one of the most significant market barriers to the creation of new care & assistance paradigms with global interconnection and interworking. UNCAP delivers an interoperable platform based on open industrial standards that leverages on existing technologies for biosensing, indoor/outdoor localisation and home-automation. The result is an open source, scalable and privacy-savvy

ecosystem compatible with existing Personal Health Record systems, that can deliver novel services that can help aging people (incl. those with cognitive impairments) live independently and with dignity.

To do so, UNCAP uses state-of-art physical/cognitive assessment tools together with technologies to locate objects, devices and users within indoor/outdoor spaces, to continuously monitor–in a non-invasive way- users and to assist them in case alert conditions are detected.

In practice, UNCAP develops a product suite for formal and informal care environments made of: 1) the UNCAP BOX (an Android consumer device connected to TVs); 2) the UNCAP App for both users and caregivers; 3) the UNCAP CLOUD, delivering scalable care services; 4) the UNCAP certification suite, to help software and hardware manufacturers assess compliancy with standards.

UNCAP will be assessed for 12 months in 14 pilots within real operational scenarios.
Pilots will be located in rehabilitation centres, daily nursing facilities etc. and will involve 750+ users and 220 caregivers. Users' physical & cognitive assessment will be carried on before and after the introduction of UNCAP to extract quantifiable metrics to assess its impact in terms of quality of care services and improved quality of life of users and caregivers.

Lastly, UNCA will carry on a RoI analysis (both financial & social), an analysis of best practices of innovative organisational/business models as well as financing/procurement models for health & care service delivery at EU level.

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
x					x		x

The UNCAP project goal was to develop an open, scalable and privacy-savvy ICT infrastructure designed to help aging people live independently. This project was focused on home environment unlike to WorkingAge which is focused on working environment. Although the application environments of both projects are different, the solutions presented in UNCAP could be interesting for the WorkingAge project.

5.4 SatisFactory

A collaborative and augmented-enabled ecosystem for increasing SATISfaction and working experience in smart FACTORY environments.

H2020– 01/01/2015 – 31/12/2017

satisfactory-project.eu

Description

"Known as either ""Industrial Revolution 4.0"" or as ""Industrial Renaissance"", the need for new manufacturing approaches is widely accepted in the EU. SatisFactory aims to contribute to the transformation of traditional industrial environments using cutting-edge technologies in ways that are both productive and appealing to youth. The fundamental component of the proposed system will be the assessment and storage of the explicit and tacit knowledge created on the shop floor by aggregating a set of heterogeneous smart devices and sensors (Linksmart/FIT, Smart Sensors/ISMB) and extracting context-aware information based on their measurements (Semantics Engine/EPFL).

The distribution of this knowledge will be based on 3 important system tools. Firstly, a training platform will allow the fast and intuitive education of employees (R3Donline/Regola).

Secondly, a collaboration platform (CoSpaces/FIT) will stimulate and promote team interactions. Finally, ubiquitous user interfaces (BRIDGE/FIT) will support all employees seamlessly in real time and on the move.

SatisFactory will also utilise the aggregated knowledge in order to leverage the control and re-adaptation of facilities (mainDSS/ABE) and streamline the workload (Human Behavior Analysis/CERTH). In order to enhance working experience and thus increase the workplace attractiveness, augmented reality and gamification (CollabReview/FIT) approaches will be utilized. Additionally modern wearable devices (ISMB; Glasses/GlassUp) will allow the interaction of workers with the system without disrupting their workflow.

All 12 foreseen products of SatisFactory will be deployed and evaluated in two industrial sites representing automotive industry (COMAU) and battery construction (SUNLIGHT). Validation will assess the impact and reveal the capabilities of SatisFactory towards the promotion of novel and viable business models for increased innovation potential, flexibility and productivity, while enhancing workplace attractiveness"

Possible synergies

50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
	x			x	x		

SatisFactory and WorkingAge projects use smart sensors in the working environment, and present advisements to the user by means of a real time interface in order to increase the productivity of the workers and their satisfaction in the working place.

6 Conclusions

Several research and innovation projects address topics similar to WorkingAge's scope. A selection was presented and potential synergies are assessed in a homogeneous schematic manner, based on a division in projects responding to the same Horizon 2020 call, other currently on-going projects, and finalised projects.

WorkingAge seems to address a unique scope and technological approach in this busy research area of healthy ageing at work. Apart from that, it is difficult to conclude further "lessons learnt" from this survey at this stage. Nonetheless, these potential synergies are a sound base for collaborations with other research and innovation projects, from which the WorkingAge and the other consortia can certainly learn.

The tables below summarise the assessments of the selected projects.

Concerning the projects under the same Horizon 2020 call, it is noteworthy that many interface and sensor technologies of WorkingAge are not addressed in other projects, e.g. E112 connection, face and voice analyses. This gives an indication of the completeness of the WorkingAge approach, and at the same time of its complexity.

Table 1. HCI included in projects from the same H2020 call

Project acronym	Mobile interface	Virtual assistant	VR/AR	Gestures	Voice	112	Platform
See Far	x	x	x				
Ageing@Work	x	x	x				
BIONIC	x						
CO-ADAPT		x			x		
SmartWork	x						
sustAGE	x						

Table 2. Sensors included in projects from the same H2020 call

Project Acronym	ECG	EEG	EMG	GSR	Gestures	Facial expression	Voice analysis	EOG	Eye movement	Pupil diameter	Ext. networks	Body pose	Noise	Vibration	Thermohygrometric	Pollutants	Illumination	Location
See Far									x	x								
Ageing@Work											x							
BIONIC												x						
CO-ADAPT																		
SmartWork	x	x													x	x	x	
sustAGE													x		x	x		x

Ageing@Work and **sustAGE** are the projects closest to WorkingAge, with a similar concept of factory pilots and for sustAGE also transport. Workplaces with sensors and feedback systems will be deployed.

On the other hand, some projects are interesting for specific technologies, e.g. **SmartWork** for cardio- and brain sensors.

Table 3. Features included in similar projects from other calls

Project Acronym	50+ Well-being	At work	Mental data	Physical data	User's environmt	RT info GUI	Enterprise system	Product enterprise
NESTORE	x			x	x	x		
CAPTAIN	x		x	x	x	x		
EMPATHIC	x		x	x	x	x		
INCLUSIVE		x	x	x				
MANUWORK		x		x		x	x	
NEVERMIND			x	x		x		x
PERSSILAA	x					x		x
CAREGIVERSPRO-MMD	x					x	x	
UNCAP	x					x		x
SatisFactory		x			x	x		

None of the projects from other calls focuses both on people of age and on work places. Some of these projects could provide information on specific topics/technologies, e.g. **NEVERMIND** on personalised Human Machine Interfaces, **SatisFactory** for worker indoor localisation and gesture interfaces.

The results of this study will be discussed with the consortium. Collaboration updates are planned to be provided six-monthly at the Consortium Meetings.

To further exploit the identified potential for collaboration, joint dissemination and communication activities will be a good start; e.g. mutual support in on-line project communication and dissemination of public results through websites, social media, towards stakeholders, etc. Additionally, the project coordinators can facilitate partner- or third party contacts regarding technology implementation, privacy handling, and other project aspects. Further collaboration opportunities are also expected to arise during the course of the project. Strategies to facilitate this are inviting project coordinators to Consortium Meetings or Expert Advisory Board meetings, joint conference presentations or joint publications.

These actions will be coordinated together with task T10.1 Communication and Dissemination strategy.