Ageing@Work

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

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Supportive, motivating and persuasive approaches, tools & metrics

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0.1	06/05/2019	First draft created by UPM
0.2	17/05/2019	Templates of benchmarking created
0.3	04/06/2019	Methodology added
0.4	12/07/2019	First results added
0.5	23/09/2019	Annexes added
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0.7	30/09/2019	Feedback from peer reviewers added
1	30/09/2019	Final version
1.1	30/03/2020	Updated with final UC from D2.1

Disclaimer

Executive Summary

This document presents the analysis and systematic review of 14 best practices, 15 technologies and 26 different applications and tools that are currently used or can be used to assist workers in maintaining their workability and well-being. Special emphasis has been placed on older workers, who suffer a greater risk of hindering their work ability and well-being, mainly due to the effects of ageing.

The systematic review has been carried out using the PICO model and has allowed the selection and classification of best practices, technologies and applications, mainly according to the problems related to human abilities (learning and cognitive functions, sensory ability, physical ability, psychology/mental abilities and workability) that are intended to be mitigated or solved and the domains or types of solutions that cover the needs in different areas of the industry (policies for the elderly, increased retirement age, improved productivity and work skills, healthy habits and adaptation and compensatory mechanisms to adapt the work environment). In addition, a mapping work has been carried out on the results obtained in the different fields (best practices, technologies and applications) with the use cases that will be implemented in the framework of the Ageing@Work project, identifying what practices, technologies and applications are more related with each use case of the two pilots.

One of the purposes of this document is to provide the necessary information to the technical partners in the project to identify the applications and tools that are of interest to be connected to the Ageing@Work platform via the open framework for worker activity and behavior tracking. Also, this document provides a thorough analysis on best practices and persuasive technologies that can be used so as to realize an effective motivating Ageing@Work Virtual Coach.

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List of Terms and definitions

Abbreviation	Definition
AG	Aktiengesellschaft (Public Limited Company)
AI	Artificial Intelligence
ANEFA	Asociación Nacional de Empresarios Fabricantes de Áridos
API	Application Program Interface
AR	Augmented Reality
AUC	ANEFA Use Case
BAB/BDS	Belastungs-Dokumentations-System (Exposure-Documentation-System)
BBM/BiFra	Beurteilung und Gestaltung von Büro- und Bildschirmarbeit sowie Mobiler Arbeit (Method for assessing and designing office and computer work as well as mobile work)
BCT	Behaviour Change Techniques
dB	Decibel
DR	Design Requirement
EDA	Electrodermal activity
EEG	Electroencephalogram
EMS	Emergency Medical Services
EU	European Union
GPS	Global Positioning System
HR	Human Resources
ICT	Information and Communication Technologies
N/A	Not available
NIOSH	National Institute for Occupational Safety and Health
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Assessment Series
OS	Operating System
OWI	Older Worker Identity
PhD	Doctor of Philosophy
PICO	P – Patient, Problem or Population. I – Intervention. C – Comparison, control or comparator. O – Outcome(s)
PPG	Photoplethysmography
R&D	Research & Development
RQ	Research Question
SDK	Software Development Kit
SOS	Save Our Souls
SUC	Siemens Use Case
SW	Software
UC	Use Case
UD	Universal Design
USB	Universal Serial Bus

UX	User Experience
VR	Virtual Reality
WAI	Work Ability Index
WP	Work Package

Table 1 Definitions

1. Introduction

The need to provide opportunities, technology, incentives and motivation so that people can continue working at an older age is crucial to tackle the challenges of the rapid aging that European workforce is suffering. These are some of the clear messages that came out of the OECD, after the revision of different policies to strengthen the labour market in older age, which was published in the report, "Live Longer, Work Longer", in 2006. After the report and based on the conclusions of the review, a set of policy guides were prepared and adopted in December 2015 as the recommendation of the OECD Council on Ageing and Employment Policies. Recent studies on the state of the labour market ratify the conclusions already obtained previously (2006). Within the framework of the Ageing@Work project, it is intended to address these challenges through the fusion of smart working and living environments, enabled through a series of highly adaptive, personalized ICT tools that will help the effective establishment of key measures to counteract for crucial issues hindering the ageing workers' workability and well-being.

1.1 Scope of the deliverable

This deliverable performs a systematic review of best practices, technologies and tools that are used in contemporary industries and factories so as to help workers and especially, ageing workers into workability, following the PICO framework (PICO: Model for Clinical Questions, 2018).

Different existing tools that support active and healthy lifestyles, from nutritional and physical activity apps through to work schedule and daily life organizers, which may be used by workers in their daily life and as such, have been analysed as they are of interest to be connected to the Ageing@Work platform via the open framework for worker activity and behaviour tracking. Also, this deliverable also provides a thorough analysis on best practices and persuasive technologies that can be used so as to realize an effective motivating Ageing@Work Virtual Coach.

This deliverable not only analyses the applicability of the best practices, technologies and tools in the project, but also maps these with the use cases that have been identified with each of the pilots and will be potentially developed within Ageing@Work.

1.2 Relation to other activities and deliverables

The current deliverable is directly related to the work that will performed in T4.1 on the open framework for worker activity and behaviour tracking, and in the Ageing@Work Virtual Coach WP5. This document is also related to D2.1 that has been developed in parallel to the writing of this document, to obtain from it the different use cases to be implemented in the pilots and thus be able to map the tools, technologies and best practices analysed with each one of them. Moreover, the deliverable D2.7 will update the D2.2 in the second reporting period being due for M22.

1.3 Structure of the deliverable

This deliverable consists of four sections plus annexes. Section 1 “Introduction” describes the scope of the deliverable, its relation with other activities within the project and the structure of the document itself. Section 2 “Benchmarking methodology and criteria” describes the methodology followed for performing the systematic audit and the templates created for this purpose. Section 3, “Results” presents the results of the analysis, identifying the most relevant parts of the applications, technologies and best practices, such as a brief description, the domains related to each of the results and the use cases to which it could be applied. The 4 section, “Overall conclusions of benchmarking”, shows the conclusions and in the annexes I to III, we can see all the applications, tools, technologies and best practices analysed.

2. Benchmarking methodology and criteria

To perform the necessary initial search of the technologies, applications and best practices, we have followed the recommendations offered by the PICO Model. The PICO process is a technique used in evidence-based practice to frame and answer a clinical question in terms of the specific patient's problem that helps to find evidence in the literature. To carry out this search, we have adapted the research questions of the PICO model to the work environment and workability, with special emphasis on older workers, as you can see in the following Table 2.

Table 2 Ageing@Work PICO design questions

What population are we interested in?	Active workers over 50 years old. No restriction about the work type
What kind of interventions are we interested in?	Any kind of tools, technologies, adaptations or best practices that cover the main domains and areas of interest (Policy for older workers, Increasing job retention (postponing early retirement), Improving productivity and workability, Healthy habits programs, Adaptation and compensatory mechanisms
Would the study need a *comparison* group?	Comparison could be with those workers or companies that do not use any kind of compensatory mechanism, tool, technology or best practice
What are the *outcomes* we are interested in?	Improvement documented in the following areas Learning and cognitive functions, sensory ability, physical ability, psychology/Mental abilities (including sleep problems) and workability (including promotion and workplace design; redeployment and transition to retirement

Using these research questions, the research team defined a common template (see Criteria for a review) oriented to facilitate the data collection to be analysed and used as input for Ageing@Work platform requirements list.

According to this template, search terms were developed iteratively by the research group. The terms within each of the five main domain categories were combined using a Boolean OR operator and then terms across the five main domains were combined using a Boolean AND operator. The complete list of terms used in our search is reported in Table 3.

Table 3 Search words

Career advancement	Work ability	Aged worker (aging at work)
Stay at work	Compensation mechanisms	Work limitation
Early retirement	Disability	Functional decline

The following electronic databases were searched; Web of Science, Sociological Abstract, PsycINFO (OVID), American Business Index (ABI) Inform. All peer-reviewed literature was included, including non-English citations.

To identify current applications of interest also the Google Play site and the App Store site of Apple have been searched using the same terms than in literature.

After completion of the searches and exclusion of duplicate results, two independent researchers from the UPM made the initial screening of included publications based on the review of titles and abstracts. Full papers and documentation of the final list of elements were obtained and distributed among the research team to be reviewed for quality and data extracted according the distributed template. In addition to the computerized search, references from included studies were also checked (i.e. snowball method) to ensure that no relevant publications had been omitted.

2.1 Criteria for a review

The benchmarked best practices, tools and technologies cover the following domains closed related with the dimensions of age management initiatives in Europe: Learning and cognitive functions, sensory ability, physical ability, psychology/Mental abilities (including sleep problems) and workability (including promotion and workplace design; redeployment and transition to retirement).

a. Domain 1: Policy for older workers: Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
b. Domain 2: Increasing job retention (postponing early retirement): Learning and training tools and technologies oriented to workability enhance based on better psychological and stress management training, work place adaptability and manage and enjoy new career challenges, in order to reduce the desire for early retirement and increase the WAI.
c. Domain 3: Improving productivity and workability: This domain includes health promotion programs based on physical, psychological and stress management training accompanied by diet counselling. In addition, this domain also reports interventions that focused on productivity, absenteeism, sickness absence and presentism, including alternatives therapies such as yoga, mindfulness or Tai chi.
d. Domain 4: Healthy habits programs oriented to promote physical activity, better nutrition, smoking cessation, and health education seminars. This domain also includes leisure educational programs and early prevention programs such as vacuums and medical check.
e. Domain 5: Adaptation and compensatory mechanisms to adapt work environment to aging functional decline to adapt work environment to chronic illness or diseases

2.2 Benchmarking methodology and templates

A detailed template was prepared for gathering best practices, technologies and tools, with a cluster of their characteristics. The main parts of the template are:

- Name of the best practice
- Short description (main characteristics of the best practice)
- Covered area or industrial sector where is applied and the type of professional and environment
- Problem addressed and how the problem is addressed in one of the following areas:
    a. Learning, cognitive functions
    b. Sensory ability
    c. Physical ability
    d. Psychology/Mental abilities (including sleep problems)
    e. Workability
- Domain/type of solution domain that cover the needs of different industry areas (according literature)
    a. Domain 1: Policy for older workers: Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
    b. Domain 2: Increasing job retention (postponing early retirement) :Learning and training tools and technologies.
    c. Domain 3: Improving productivity and workability: Physical activity programs tools New therapies Yoga, Taichi, Mindfulness Leisure programs.
    d. Domain 4 Healthy habits programs Nutrition, Physical activity, Leisure and sleep educational programs, Vacuums and medical check (early prevention programs).
    e. Domain 5 Adaptation and compensatory mechanisms To adapt work environment to aging functional decline To adapt work environment to chronic illness or diseases.
- Need of training to implement the motivational approach or/and the best practice
- Results and benefits: Describe the results of the application of the best practice in the described environment. Include the number of involved people, and indicators of improvement in the workability (example, Index WAI)
- Applicability limitations

In case of tools and technologies additionally, the following information is gathered:

- Technical limitation or applicability limitations
- In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)
- Interoperability with other solution

3. Results

In total 65 templates were filled, which can be found in the Annex I, II and III. Every of the elements were analysed, classified according the usefulness of the tools, technology, sensors, or best practice in each of the use cases defined during the first six months of the project for each of the pilot deployment. The complete list of use cases and a short description extracted from D2.1 is in Table 4 .

Table 4 Use Cases

UC nº	UC name	Short description
UC1	Check-list platform	Through this application scenario, the machine operators will be able to check the safety elements related to the task of their shift. Taking as a starting point the current manual process, the checklist platform will be interactive, will speed up the process and try to make it more secure both for the operators and for the machines. In case that something will fail, the right alarms will be triggered (both to the manager and/or to an experienced person in charge).
UC2	Participatory work orchestration	The work-orchestration-tool is an essential planning tool for the factory manager. Due to the, usually high, number of employees on the work floor and their different skills, in terms of being certified for different machines, various apprenticeships and additional qualifications, the manager may miss some of these details when trying to organize the upcoming period's (e.g. week's) shift plans. Through the platform, the workers will communicate requests for absences or vacations to the people in charge of personnel, while the aim of the overall system will be to facilitate and simplify flexible work management, both at the ageing worker and at the management side of the company.
UC3	Support for musculoskeletal problems	The system will suggest, through the Virtual Coach, physical exercises or stretches to the worker to do at home or at work, so as to help the user reduce or avoid musculoskeletal problems. This will be coupled with workplace ergonomics assessment, while it can also interact with job scheduling (e.g. worker is not assigned tasks with weight lifting in case of back pain).
UC4	Supporting health and well-being – Virtual Coach	The overall aim of this UC is to have the Ageing@Work virtual coach motivating users to behave in ways that can improve their health and well-being. The system based on the worker's information about his/her marital status and obligations (childcare, elderly parents) and his/her daily/social activities and behaviour will provide advice to the worker so as to help him/her in this respect. In this context, the system will monitor several aspects related to the worker's behaviour and routines, in terms of daily activities at work and beyond, as well as aspects of the quality of sleep and level of perceived stress, using a multi-parametric approach; the aim will be to provide personalized recommendations on ways to reduce the negative symptoms and fight the causes, towards supporting health and well-being.

UC5	Knowledge exchange platform and intergenerational collaboration support	The aim of this use case is to support transferring the long-term experience of older workers to the younger ones. On one hand, older workers share with young workers, experiences, tips and tricks for the best development of their activity. Alongside, the AGEING@WORK system provides advanced interfaces (including VR, AR) so as to support workers' remote collaboration through telepresence. Finally, workability enhancement is further empowered by advanced VR and AR-based Life-Long Learning tools.
UC6	Productivity enhancement tools	Productivity enhancement tools empowered by advanced ICTs, focusing on helping ageing workers into advanced situation awareness while at the workplace, are provided here so as to support workability despite ageing. The use of AR tools will be employed, so as to help into early identification of some urgent issue in the production line, as well as smartwatch devices to help workers who observe multiple machines, to be better aware of their status and upcoming steps. A smart watch can offer the same functionality as a mobile phone or tablet, but it is always on hand, could not be lost and does not occupy any hands. This will reduce stress, as the worker always knows the status of his machines without running around with the fear that some events could be missed.
UC7	Emergency/Panic button	In case of emergency, this use case will allow the worker in distress to notify the management/security side of the plant and be directly geolocated if possible (especially in large areas of land), as well contacted by the security personnel. Moreover, context/environmental details will be transferred to security personnel.

3.1 Tools and technologies

Following sections present a short summary of the main characteristics of the technologies, applications and tools included in the benchmarking. The explanation of each of them tries to include the most relevant information for the Ageing@work purposes. In addition, in case of technologies widely used in the research and real-life environment to support worker, an extra analysis was done in order to identify the main characteristics, differences and other elements of interests that facilitate the future development of Ageing@work final solution.

3.1.1Technologies

Technologies to improve the workability refer to any kind of technique, skills, method or processes used in the production of goods or services or in the accomplishment of objectives that serve to increase or improve the worker capability of being put into effective operation; practicable or feasible.

In order to better understand the usefulness of each of the technology, we have included the Table 5, with the general description of each of the technologies and a summary of the benefits of each of them for Ageing@work purposes, linked each of the elements with main domains and use cases addressed by the project /Table 6). Finally, some graphs classify the technologies analysed per UCs and per domain of use. References of the included technologies are in Annexes section.

Table 5 Technologies

Name of the technology	Description
BAB/BDS	The BAB/BDS method supports organizations effectively, efficiently and management-related in the planning and design of future work systems and in the assessment of the working conditions of existing work systems as well as in the control and controlling of these tasks at the level of operational management.
BBM/BiFra	It is a web-based method that first allows the employee to self-assess the applicable working conditions. The single result shows design deficits and gives hints for improvement.
Ergonomics	Ergonomics is a complete mobile workplace health solution that offers equipment setup advice, a variety of workplace specific stretching exercises, and programmable reminders to help you time your breaks.
American Red Cross First Aid emergency technology	The official American Red Cross First Aid app puts expert advice for everyday emergencies in your hand. Get the app and be prepared for what life brings. With videos, interactive quizzes and simple step-by-step advice it's never been easier to know first aid

Nintendo Wii PlayStation Move (Sony) Xbox & PC Kinect (Microsoft)	Exergaming relies on technology that tracks body movement or reaction. The genre has been credited with upending the stereotype of gaming as a sedentary activity and promoting an active lifestyle. Exergames are seen as evolving from technology changes aimed at making video games more fun.
Wearable wristbands	Wristband-type wearable health devices equipped with biosensor systems (e.g. heart rate sensor) that measure the physical demands of workers
Wearable and augmented reality	Some practical issues were raised concerning the simultaneous use of multiple devices and the placement of the devices. The system was proposed for the maintenance work.
Digital Human Modelling of obese and aging workers in automotive manufacturing	Through use of CATIA Delmia (Dassault Systémes) digital human modelling software tool, this research investigates how modeling software can be utilized in a number of ways to depict variations in worker size and age, for planning manual assembly and other work tasks.
iHeart	The technology combines a fingertip device to measure blood oxygen saturation and heart rate, an app for smartphone or tablet and personal online dashboard to determine Internal Age by measuring the stiffness of the aorta. Aortic stiffness is a proven metric for overall organ health and is capable of predicting risk of death from all causes.
Teleworking	Employers provide the possibility to employees to work from home instead of commuting to office and work there.
Sensor network	Sensor technology in the workplace to monitor work and health parameters and provide real time feedback to the user. They would like to receive real-time feedback from sensor technology applications to prevent exceeding exposure limits for heat, noise or lifting.
Smartcap technologies	Wearable technology that eliminates microsleeps by providing accurate alertness measurements in real-time to operators and drivers so they can take charge when it comes to safety, and monitor their fatigue.
Smartphone	Randomised-controlled trial was conducted with individuals reporting work stress (n = 136). Participants were randomised to the experimental, control or waitlist condition (resp. EC, CC, WL). The EC and CC registered emotions five times daily for four weeks. The EC additionally received a worry-reduction training with mindfulness exercises. Primary outcome was 24-h assessments of HRV measured at pre-, mid- and post-intervention. Secondary outcomes were implicit affect and stress.

Samsung Smartphone	Samsung Smart Phone S10+ is a device, to be used during the work shift and at home by workers, to get real-time health through Samsung Health. It combines sensors and models to obtain real time feedback on user's performance, motion and vitals.
Samsung Smartwatch	Samsung Watch Galaxy Watch Active is a wearable device, to be used during the work shift and at home by workers, to get real-time health through Samsung Health. It combines sensors and models to obtain real time feedback on user's performance, motion and vitals.

A total of 13 different types of technologies have been analysed. The distribution per domain is represented in Figure 3, with a majority of technologies for Domain 2: Increasing job retention and Domain 3: Improving productivity and workability.

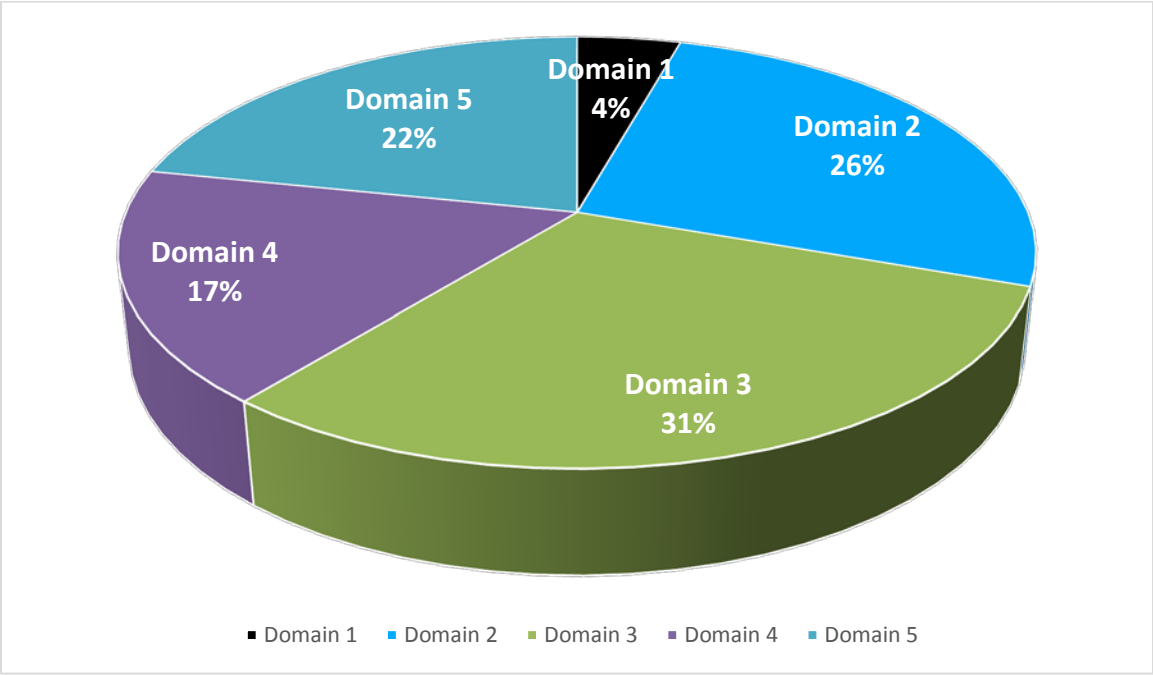

Figure 1 Distribution of technologies per domain

These domains distribution also in appreciated in the analysed technologies distribution per use cases, with a clear majority of applications found in those uses cases related with physical status and well-being. UC3: Support Musculoskeletal problems and UC4: Support health and well-being. The graphical distribution of technologies is represented per pilot site in the Figure 2.

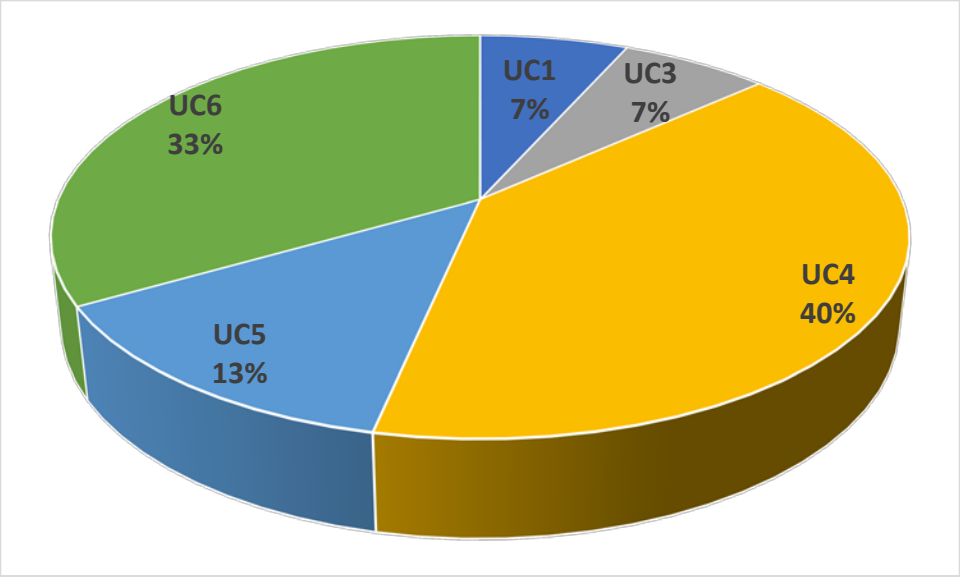

Figure 2 Distribution of technologies per UCs in each of the pilots

Finally, detailed information about these apps and tools are included in Table 6.

Table 6 Selected technologies mapping with Ageing@work specific domains and pilot use cases

Technology	Problems addressed	Domains	UCs	Relevant comments for Ageing@Work
BAB/BDS	Learning, cognitive functions Sensory ability Physical ability Psychology/Mental abilities	Domain 1 Domain 2 Domain 3 Domain 5	UC4	The main utility of the technology is oriented to perform a first analysis of the situation of the user and then use the results to apply one or various use cases solutions.
BBM/BiFra	Learning, cognitive functions Sensory ability Physical ability Psychology/Mental abilities	Domain 2 Domain 3	UC4	The main utility of the technology is oriented to perform a first analysis of the situation of the user and then use the results to apply one or various use cases solutions.
Ergonomics	Learning, cognitive functions Physical ability	Domain 2 Domain 3 Domain 4	UC6	The adaptation of the model to factories and quarries work will be necessary for Ageing@work uptakes.
American Red Cross First Aid	Learning, cognitive functions	Domain 4 Domain 5	UC7	There is not direct application in the UCs, therefore, it could be useful as extension to support UC7, and provide guidance for Panic Button users first aids.
Nintendo Wii PlayStation Move (Sony) Xbox & PC Kinect (Microsoft	Physical ability Psychology/Mental abilities	Domain 3 Domain 4	UC4	A total of 22 empirical studies met inclusion criteria and were included in this review. Positive effects included improving physical function, decreasing depression, and increasing cognition and quality of life in older adults. Improved socialization and motivation to exercise were also reported.
Wearable wristbands	Physical ability	Domain 2 Domain 3	UC4 UC6 UC7	The sensor could be applied to several UCs, therefore, according the results of ANEFA focus groups, some of the users could have restriction to use them because work safety rules.
Wearable and augmented reality	Learning, cognitive functions	Domain 2 Domain 3	UC1 UC5 UC6	The systems are usually a research prototype.

Technology	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Digital Human Modelling of obese and aging workers in automotive manufacturing	Learning, cognitive functions Physical ability	Domain 5	UC3	
Teleworking	Physical ability Psychology/Mental abilities	Domain 2 Domain 5	UC5 UC6	Describe the results of the application of the tool or technology in the described environment. Include the number of involved people, and indicators of improvement in the workability (example, Index WAI).
Sensor network	Physical ability Psychology/Mental abilities Learning, cognitive functions	Transversal	Transversal	Real-time feedback on work and health aspects, such as physical strain, fatigue, heat and noise, provided by sensor technology applications may be used to prevent unhealthy work activities and adverse health outcomes. Hazardous work situations can be avoided and health behaviour may be improved. Individual reports may help to open a dialogue with the relevant work and health stakeholders about improving workplace health.
Smartcap technologies	Physical ability Psychology/Mental abilities	Domain 5	UC4	The headband only works with the Life app.
Smartphone	Psychology/Mental abilities	Domain 3	UC4	The technology used does not solve the problem of work stress. The app used doesn't gathers any variables, as it provides mindfulness training audios.
Samsung Smartphone	Sensory ability Physical ability Psychology/Mental abilities	Domain 4	Transversal	The device could be applied to several UCs, therefore, according the results of ANEFA focus groups, some of the users could have restriction to use them because work safety rules.
Samsung Smartwatch	Physical ability Psychology/Mental abilities	Domain 4	UC4 UC6 UC7	The sensor could be applied to several UCs, therefore, according the results of ANEFA focus groups, some of the users could have restriction to use them because work safety rules.

Since the use of several technologies such as wearable waistband is very common in recent research project, we have explored their specific usage and the results in some of relevant EU funded project. Following table present a summary of the findings.

Project/device	Application	Main findings
INCLUSIVE – Smart and adaptive interfaces for INCLUSIVE work environment Empatica E4 wristband	The E4 wristband is a wearable research device that offers real-time physiological data acquisition and software for in-depth analysis and visualization on the computer and real-time visualization on the application for smartphones. It has got four sensors: • PPG Sensor - Measures Blood Volume Pulse (BVP), from which heart rate and heart rate variability can be derived • EDA Sensor (GSR Sensor) - Measures the constantly fluctuating changes in certain electrical properties of the skin • 3-axis Accelerometer - Captures motion-based activity • Infrared Thermopile - Reads peripheral skin temperature	Device very vulnerable to artefacts and the signal is very loud, especially in the move.

3.1.2 Tools and applications

In this section tools and application to increase the workability are analysed. In the case of tools, we have considered any type of software that enable to do a task easier and in the case of applications we have consider any kind of computer program or a set of software that the worker can use for a specific and well-defined purpose.

In order to better understand the usefulness of each of the tool and application, we have included the Table 7, with the general description of each of the tools and application and a summary of the benefits of each of the tools for Ageing@work purposes, linked each of the elements with main domains and use cases addressed by the project. Finally, some graphs classify the tools and application analysed per UCs and per domain of use. References of the included tools and applications are in Annexes section.

Table 7 Tools and applications

Name	Description
JumpStart	Intelligent, personalized, ergonomic footbeds as shoe inserts with transferable sensors and electronics that collect health, wellness and fitness data in combination with the corresponding app Holmz.
Ladder Safety	The NIOSH Ladder Safety application features a multimodal indicator, which uses visual, sound, and vibration signals to assist the user in positioning a ladder at an optimal angle.
Oiva	A Mobile Phone Intervention for Improving Psychological Flexibility aims to increase psychological flexibility and improve mental and physical wellness, based on the Acceptance and Commitment Therapy (ACT)
Vault Check	It is a health and safety app which provides the possibility to carry out inspections on mobile devices without the need of paper checklists.
Vault Notify	It is a safety app which provides the possibility to capture information on a workplace event, incident or hazard from any location in real time.
Lifesum	Diet plan, food diary, macro calculator, calorie counter & healthy recipes in one app. Meal planner & macro tracker - TOP Lifesum features: • Diet plan & diet tips for any goal • Keto, vegan, 5:2 and more diets & plans • Calorie counter & food tracker with barcode scanner for easy logging • Macro calculator • Physical activity tracker • Food planner • Health tracker Nutrition data as well as physical activity data are being entered manually by the user.

Name	Description
Tap into safety	Using specific organizations existing workplace health and safety data to build an individualized, interactive and immersive hazard perception training solution to complement existing workplace training. Cloud-based interactive training modules can be completed in under 15 minutes and are available online and via smart devices. Through using 360-degree panoramic photography the workplace safety training solution allows staff to interact with the gaming platform to determine if there are any gaps in their safety knowledge. This allows organization to assess, measure and improve hazard perception through detailed results and reports.
Ada	Based on symptoms entered and answers to the questions, this app suggest diagnosis, describes risks, treatment, prevention, prognosis and next steps. User can also share their health data with their doctor (as described on the website but I have not find this option after downloading the app on my smartphone) and share as PDF with their contacts. This app gets to know the user and gives health information specific to them (e.g. sex, age).
Daily Yoga	Focused on yoga for weight loss, beginner to advanced, better sleep & full relax.
dB Volume Meter	The app shows the approximate dB (decibel) level, also known as Sound Pressure Level (SPL).
Physical activity trackers	These apps are designed to track users' workouts, provide audio feedback along the way and offer guidance on how to reach users' goal. Enable to view and track health, such as weight, steps, calories burned, heart rate and more. This app combines the data from several devices and services:
SOAR	SoAR is an open source, Android-based mobile app that is entirely free to use. Once an individual register as a user, the app enables access to video calls for any contacts from the user's phone contact list. The video stream shares what each participant sees (i.e., the back-camera view) rather than a face view of the participant (i.e., the front camera view). The audio can be muted from both side if necessary, and each participant in a call can choose to view the current view or to switch the shared view to the back-camera view at any point.
Aqualert	Water/hydration tracker and reminder Features: Notifications; Water Intake calculator with users' gender, weight and activity level; Tracker and Reminder with automatic bed time mode; Graphical display of users' hydration level and daily consumption; Charts and indicators; Customize serving; Messages to encourage to drink more water.

Name	Description
Kenzen Patch	Kenzen Patch is a small device, to be worn during the work shift by workers and technicians, to get real-time health and safety information. It combines sensors and predictive models to obtain real time feedback on user's performance, motion and vitals. The core models are based on sweat biomarkers, such as sodium, glucose and proteins. Kenzen's technology allows molecules like these to be collected and measured non-invasively using proprietary sensors.
Affrytrac Mobile	It is a web-based tool for the management of environmental health and safety compliance requirements in a working environment. Its main features include task management, corrective actions documentation and tracking, potent compounds repository, safety self-assessment tool
Dangerous goods manual	The application helps in identifying hazardous material (HazMat). Its main features include: search hazardous materials (by UN number), ERI-Cards ("Emergency Response Intervention Cards") to guide on initial actions for fire crews, - Information about hazard identification numbers (Kemler number), Hazchem Emergency Action Codes (EAC), Packaging groups, Transport category and Tunnel codes, classification and labelling summary (including GHS)
Fatigue Predictor	Fatigue Management tool based on a commonly used fatigue model of calculating an Individual Fatigue Likelihood Score (IFLS).
iHeart	The technology combines a fingertip device to measure blood oxygen saturation and heart rate, an app for smartphone or tablet and personal online dashboard to determine Internal Age by measuring the stiffness of the aorta. Aortic stiffness is a proven metric for overall organ health and is capable of predicting risk of death from all causes
Incident cost calculator	This application uses sample accident and industry scenarios from a number of industries to calculate the financial cost of a workplace incident.
Drink water reminder	It is an Android APP that reminds you to drink water. It allows to set a target amount of water and the size of the glass. It reminds you to drink regularly. Based on the size of the glass, the APP also calculates the amount of water that was drunk the day.
PFO wearable security	PFOtech offers secutity technologies based on GPS Braceltes with SOS functionality and the corresponding Software / APPs

Name	Description
Pill Reminder & Medicine Alarm	Medicine tracker app that reminds to take medicines punctually. The user can add medicine details like the time to take medicines, daily schedule, dosage, with or without food, doctor details, and medicine shapes and edit your medication schedule, add a new pill, remove existing prescription or replace it with a more actual one at any time you want
Safety compass	The Safety Compass uses intuitive augmented reality and interactive mapping to communicate hazard information to users in the field. By accessing the worker's physical location, the app presents vital information on present dangers straight to the worker's phone, avoiding the necessity of bulky safety manuals to locate and manage risk. Using the phone's inbuilt camera and GPS system, the app displays real and present dangers to the viewer that adapt and compensate for the viewer's field of vision.
YAZIO Calorie Counter,	It's a free app for calorie counter. It allows to manage the daily food diary, track activities and give support to lose weight. It syncs with Google fit. The Pro version has nutrition plans and a coach to remind eating and drinking.
Samsung Health	Samsung Health is an application and platform that supports,t racking various aspects of daily life contributing to wellbeing such as physical activity, diet, and sleep, and provides a dashboard which shows on one page a general overview of the most recent data saved. In addition, it provides direct access to each feature. Its composition and layout are customizable.

A total of 25 different types of applications and tools have been analysed. The distribution per domain is represented in Figure 3, with a majority of applications and tools for Domain 3: Improving productivity and workability: Physical activity programs tools and Domain 4 Healthy habits programs Nutrition, Physical activity.

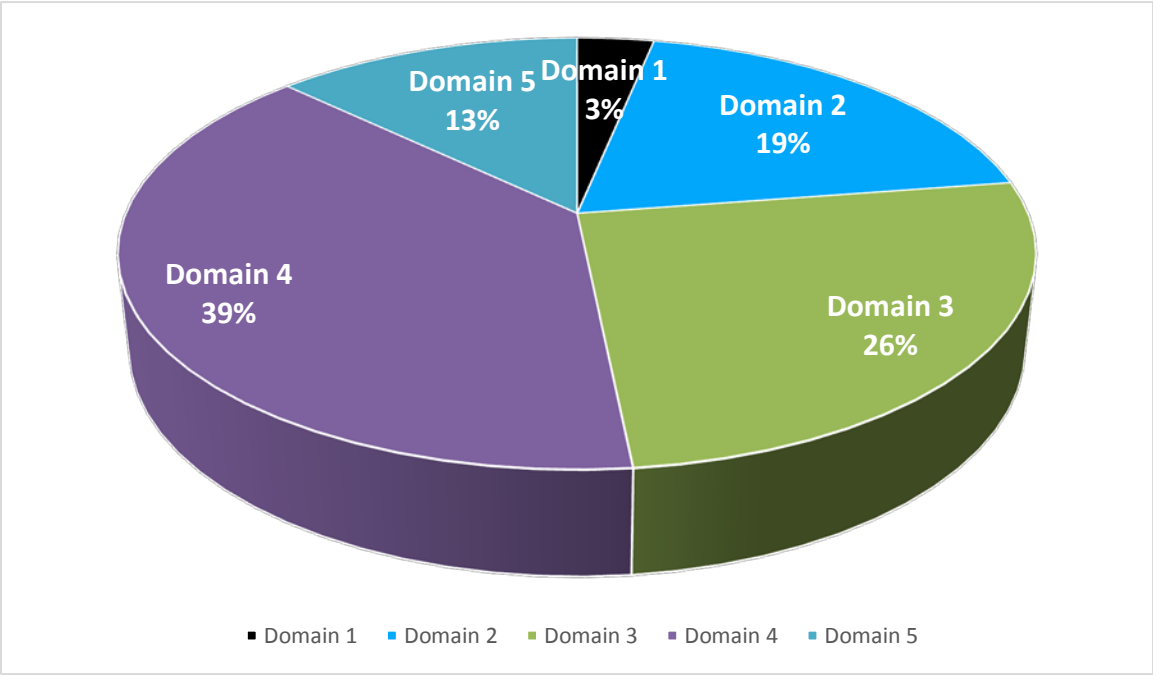

Figure 3 Distribution of applications and tools per domain

These domains distribution also is appreciated in the analysed apps and technologies distribution per use cases, with a clear majority of applications found in those uses cases related with physical status and well-being. UC3: Musculoskeletal problems and UC4 Supporting health and well-being. The graphical distribution of tools is represented per pilot site in the Figure 4 Distribution of applications and tools per UCs in each of the pilots.

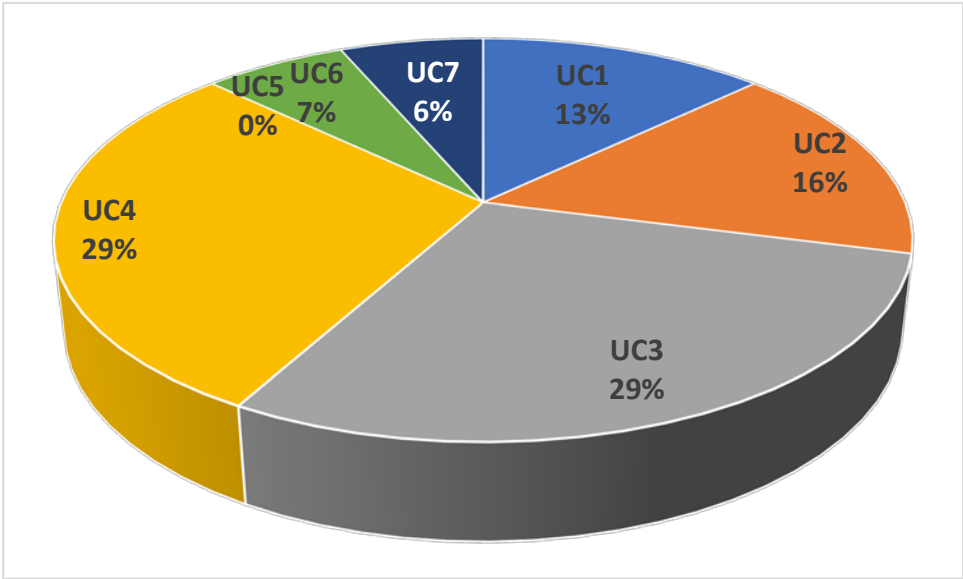

Figure 4 Distribution of applications and tools per UCs

Additionally, there are 4 additional tools and applications, three directly related to well-being and physical performance (hydration reminders and pills dispensers) that some of their functionalities could be useful to be included as additional functionality for specific personas. The other one (Safety compass) could be useful as support in emergency situations in the factories.

Finally, detailed information about these apps and tools are included in Table 8.

Table 8 Selected applications and tools mapping with Ageing@work specific domains and pilot use cases:

Application	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
JumpStart	Physical ability	Domain 3 Domain 4	UC3	
Ladder Safety	Learning, cognitive functions	Domain 4	UC2 UC6	There are no UCs that fit with this application, but the methodology used to teach and to show information could be useful to be applied into the proposed UCs
De Korte et al (systematic Review)	Physical ability Psychology/Mental abilities	Domain 3 Domain 4 Domain 5	UC4	
Oiva	Learning, cognitive functions Physical ability Psychology/Mental abilities (including sleep problems)	Domain 3 Domain 4	UC4	Oiva could be used as an effective tool for slight overweight persons improving their work ability. The tool shows a psychological flexibility related to work ability and perceived stress mediated the effects of the mobile intervention
Vault Check	general health and safety issues	Domain 2	UC1 UC2	Short learning phase for understanding the functions and operation of the app. Easy to use for all skill levels, but inspections should be carried out under the supervision of experts of health and safety issues. The tool enables to perform digital checklists for efficient inspections, customised checklist templates for consistent inspections. Possibility to collect and store evidence through photographic and video functionality. Schedule activities by time frames for inspections or activities and assignment to other people.
Vault Notify	safety issues	Domain 2	UC7	Short learning phase for understanding the functions and operation of the app. Easy to use for all skill levels, but safety hazards and incidents should be under the supervision of health and safety managers. This tools directly doesn't address UC7, but could be very useful as additional tool in post-accident management

Application	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Lifesum	Physical ability	Domain 4	UC4	Lifesum integrates with Google Fit and S Health, so one can export nutrition and exercise data from Lifesum to Google Fit and S Health, and import fitness data and weight and body measurements back to Lifesum. Syncs with fitness apps such as Moves, Nokia Health, FitBit, Jawbone, Endomondo and Runkeeper
Tap into safety	Physical ability Psychology/Mental abilities	Domain 2 Domain 3	UC1 UC3	
Ada	Sensory ability - Physical ability - Psychology/Mental abilities	Domain 4	UC3 UC4	
Daily Yoga	Physical ability Psychology/Mental abilities	Domain 3	UC3 UC4	
dB Volume Meter	Sensory ability	Domain 4	UC3	
Physical activity trackers	Physical ability	Domain 3 Domain 4	UC3	Require from adaptation in order to fit with the requirements proposed during the focus group
SOAR	Learning, cognitive functions	Domain 1 Domain 2	UC1 UC2 UC6	The field study outcomes suggest that the SoAR app is a potential solution, especially for acute and ad hoc work situations. In sum, SoAR could improve communication in quality and supply chain management work processes in the construction and facility maintenance sectors.

Application	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Aqualert	Physical ability	Domain 4	NA	Entering the amount of water drunk manually - requires user's attention and willingness to enter
Kenzen Patch	Physical ability	Domain 4	UC3 UC4 UC7	Applicability is limited to conditions that can be detected on the basis of sweat biomarkers, combined with other sensors such as HR, temperature and accelerometer sensors.
Affrytrac Mobile	Learning, cognitive functions	Domain 2	UC1 UC3 UC4	The use of the application contributes to spending less time to in the office managing health and safety and environmental requirements. It facilitates environmental, health and safety compliance monitoring across multiple locations, time zones and languages.
Dangerous goods manual	Learning, cognitive functions	Domain 2	UC1	These app can be useful to design the specifics solutions in these UCs
Fatigue Predictor	Learning, cognitive functions Psychology/Mental abilities	Domain 3	UC7	Fatigue was one of the main topics addressed by worker in ANEFA pilots, so this app could be very useful in the design of specific solutions oriented to safety.
ihEART	Physical ability	Domain 3	UC3 UC4	
MyFitnessPal	Sensory ability Physical ability Psychology/Mental abilities	Domain 5	UC4	
Drink water reminder	Learning, cognitive functions	Domain 4	NA	Statistic about the amount of water drunken per day / per month
PFO wearable security	Transversal	Domain 5	UC1 UC4	It doesn´t solve any problems, but it helps all person to get help in danger or critical situations. It could be helpful as a bodyguard for kits but also for lone workers, hikers, persons with cognitive impairments,

Application	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Pill Reminder & Medicine Alarm	Physical ability	Domain 4	UC1	
Safety compass	Sensory ability	Domain 5	Transversal	Very interesting for quarry safety
YAZIO Calorie Counter	Physical ability	Domain 4	Uc4	It's a proprietary app and even though it syncs with google fit, this limits the applicability, also because the data must be entered by the end users, not by wearables.
Samsung Health	Learning, cognitive functions Physical ability Psychology/Mental abilities	Domain 2 Domain 3 Domain 4	UC4	

The exercise is not directly addressed by none of the proposed UCs but is very related to physical and psychological problems of mature workers associate to bad health habits and sedentary lifestyle. Indirectly are related with AUC3 and SUC3, so that here summarize some of the available applications that we have found in the market, and the main differences between them.

Table 9 Summary of the applications and tools directly related with physical activity promotion

Name	Description	Operating system	Comments
Google Fit	In general, Google Fit is a platform that supports the following: • Discovering sensors on users' devices • Collect data from these sensors regarding users' physical activity • Store personal data in the Fitness Store, • Access data stored in the Fitness Store, • Access and manage users' "fitness history",	Android	The platform can be accessed through two types of APIs: • Android APIs for Android apps • REST API for apps on any platform

Name	Description	Operating system	Comments
Health Mate	Enable to view and track health, such as weight, steps, calories burned, heart rate and more. This app combines the data from several devices and services: Fitbit, Microsoft Health, Withings	Android IoS	Health Mate links with 100+ top health and fitness apps including Apple Health, Nike, RunKeeper & MyFitnessPal
FitToFit - Fitbit to Google Fit	This application helps to transfer measurement data from FitBit wristband to Google Fit - a health-tracking platform developed by Google for the Android operating system and Wear OS (Google's Android operating system designed for smartwatches and other wearables). It means it can be used by FitBit and Google Fit users only.	Android	FitBit wistband Google fit
Endomondo	Endomondo is designed to track users' workouts, provide audio feedback along the way and offer guidance on how to reach users' goal. It syncs with Endomondo.com, where you can access a full training log and analyse your fitness activity	Ios Android Distance, duration, pace, calories retrievable via API (e.g. unofficial API https://github.com/fabulator/endomondo-api)	Integrated with Jabra, Garmin, myfitnesspal, Polar, Timex, wahoo fitness, withings, Zephyr, Fitbit, Suunto
Heart Trace	Heart Trace automatically checks heart rate at regular intervals via your Android Wear smartwatch and syncs heart rate data with Google Fit. Users can view their heart rate by the day, hour or minute or as a daily summary.	Android	Android wear based device Google Fit account

Name	Description	Operating system	Comments
Step Counter	This pedometer uses the built-in sensor to count steps. No GPS tracking, so it can greatly save battery. It also tracks burned calories, walking distance and time, etc. All this information will be clearly displayed in graphs. Features: Save Power; No locked Features (All features are 100% free); No sign-in required; Report Graphs (user can check last 24 hours', weekly and monthly statistics in graphs); Backup & Restore Data from Google drive.	Android 4.1 or up	
MyFitnessPal	Use of wearable and augmented reality technologies in industrial maintenance work: Augmented Reality System for Task Guidance The wearable system was developed to improve communication between the information systems and a maintenance technician. The system was proposed to facilitate on-site reporting system and to shorten the reporting time afterwards. Augmented Reality System for Task Guidance was designed in order to give more comprehensive and interactive guidance for the maintenance technician. The system was built on an iPad Air tablet using Metaio Creator. The user interface was Junaio.	Applicability may depend on the complexity of the tasks to be supported, that in some cases may not be amenable to a "point-the-camera-and-see" approach, typical of AR application to repair support	

Samsung Health	Samsung Health app provides users with a comprehensive view of their fitness. It also includes activity goals based on recommendations from the American Heart Association and the World Health Organization (i.e. move minutes and heart points). Samsung Health is intended to help users manage their overall health and wellbeing through capturing and tracking health related information and metrics and through providing access to articles and similar materials that may be of interest to users. All information provided is for general guidance only. Therefore, the app itself cannot be used for medical purpose.	Android	

3.2 Best practices

In this section best practices to increase the workability are analysed. In order to better understand the usefulness of each of the tool and application, we have include the Table 10, with the general description of each of the best practices and a summary of the benefits of each of the best practices for Ageing@work purposes, linked each of the elements with main domains and use cases addressed by the project. Finally, some graphs classify the best practices analysed per UCs and per domain of use. References of the included best practices are in Annexes section.

Table 10 Best practices

Name	Summary
AGINGAT WORK: The moderating role of age in occupational wellbeing	The PhD dissertation presents studies proving that employability is an important factor in the older workers' intention to retire process, and in order to motivate older workers to engage in employability activities and work longer, age stereotypes need to be combated. However, in the view of generating a future time perspective in managing employability of both older age groups (55-60, 60+), creating job support for learning over the life stage is also increasingly important.
Psychosocial Factors Impacting Workplace Injury Rehabilitation: Evaluation of a Concise Screening Tool	A correlation was observed between delayed workplace injury recovery and poor perceived workplace and home social support. Path analysis found workplace support to be a significant moderate-to-strong predictor of number of days until return to full capacity (DTFC). The HCG may be an effective tool for identifying these factors in musculoskeletal workplace injuries of a minor patho-physiological nature.
Guideline for the Implementation of Human-Oriented Assistance Systems in Smart Factories	The guideline developed in this paper provides an orientation and basis for the company-internal discussion during the introduction of new assistance systems in assembly. Particular attention is given to communication with employee representatives. The central goal of this implementation concept is to provide the employees with the help of a socio-technical design approach using Industry 4.0. The advantages and opportunities include, in particular, the flexibilisation of the work, the computerization of the workplace, the competence development of the employees and the assistance of the employees.
The impact of the working environment on work retention of older workers	The Report concludes that the Norwegian labour market participation and retirement behaviour among older workers are affected by a multitude of factors at the macro, meso and micro level. They include factors not related to the work environment, such as labour market situation, including the business cycle, downsizing and unemployment, financial incentives and other features of the pension system and social insurance system, social position (sex, educational level and occupational position), gender, civic status, spouse's labour market situation and retirement, and (to a lesser degree) caring responsibilities. However, health, work ability and work environment seem to be

	among the most important factors.
Name	**Summary**
Additional Leave as the Determinant of Retirement Timing—Retaining Older Workers in Norway	The analysis shows that offering additional leave as a retention measure reduces the individual relative risk of withdrawing a contractual pension (AFP) in the next two years of employment among older workers between the age of 61 and 62 years.
Older Worker Identity and Job Performance: The Moderator Role of Subjective Age and Self-Efficacy	The authors analyse the concept of "older worker identity" OWI is accompanied by the acceptance of negative characteristics of oneself, such as resistance to change, poor performance, or low work motivation. It is a proven fact that identification promotes the probability of acting consistently with the category with which the person is identified, so OWI can be an antecedent of undesirable behaviours, such as the decline in performance at work. The conclusion is that organizations should pay special attention to their older workers' appraisals.
The Employability of Older Workers as Teleworkers: An Appraisal of Issues and an Empirical Study	The study examines the prospects for the employability of older workers as home-based teleworkers The study results in a mixed picture with respect to the employability of older workers as teleworkers, and strongly suggests that less experienced managers would be more resistant to hiring older people as teleworkers. The authors provide recommendations that employers may follow to improve the prospects for employability of older teleworkers
Current and future industrial changes: Demographic change and measures for elderly workers in industry 4.0	Age-related changes of human work ability and the role age-appropriate work design and standardization as well as assisting can play to enable elderly workers for the future industrial work setting, based on a study conducted in Austria in 67 industries of various sectors. It proposes a set of measures and possible solutions for age-appropriate working.
Universal design frameworks for policies in the workplace: Case studies and best practices	The purpose of the study is to explore and document factors that were hypothesized to lead to successful implement of workplace policies that for addressing the physical, psychological and social needs of a workforce with diverse abilities. Universal design enables the access of a workplace to the greatest extent possible by all people regardless their age, size, ability or disability. This makes the workplace more efficient and safer for workers.
Lessons learned from the Kronos research project	Following recommendations have emerged of the project: • A uniform reduction of working hours is not recommended due to the huge diversity among the individuals • Older employees who do hard work shall have the possibility to take frequent breaks • Shift systems based on fast forward rotation should be preferred • Reduce the number of night shifts per person per year • Working-time choice and sabbatical options should be offered

Siemens locations are OHSAS 18001 zertifiziert	OHSAS 18001: Identify risks due to accidents or overload in good time and implement effective measures to protect your employees.
Time4You	Time4You enables employees to take additional days off and thus creates space and flexibility for individual time planning.
Developing an Extended Model of the Relation between Work Motivation and Health as Affected by the Work Ability as Part of a Corporate Age Management Approach	It aims at developing an extended model of the relation between work motivation and health as affected by work ability and at deriving a host of measures that enterprises can apply as part of a corporate age management policy to counteract the impact of demographic changes.

A total of 14 different types of best practices have been analysed. The distribution per domain is represented in Figure 5, with a majority of best practices for Domain 2: Increasing job retention, Domain 5: Adaptation and compensatory mechanisms and Domain 1: Policy for older workers.

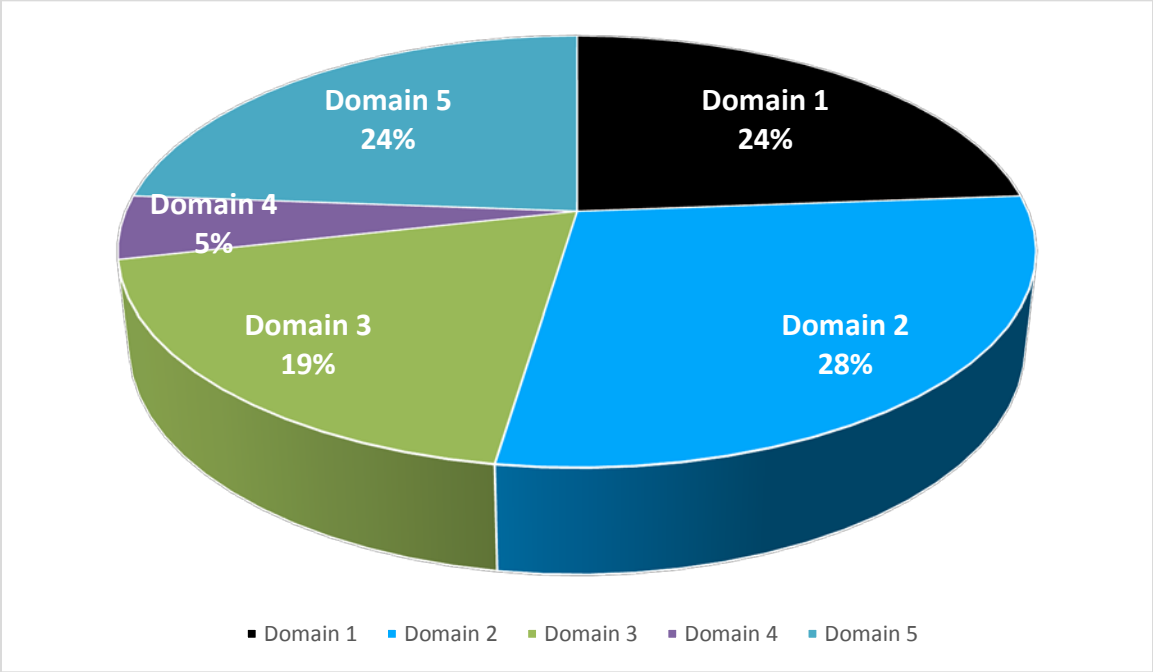

Figure 5 Distribution of best practices per domain

These domains distribution also is appreciated in the analysed best practices distribution per use cases, with a clear majority of applications found in those uses cases related with physical status and well-being UC4: Supporting health and well-being and UC3: Support MK problems. The graphical distribution of best practices is represented per pilot site in the Figure 6.

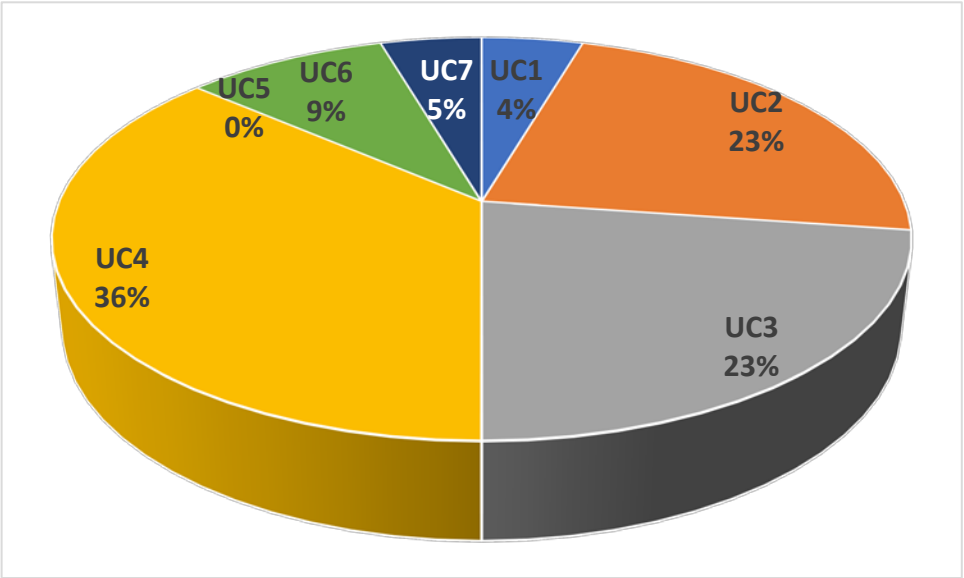

Figure 6 Distribution of best practices per UCs

Finally, detailed information about these best practices is included in Table 11.

Table 11 Selected best practices mapping with Ageing@work specific domains and pilot use cases:

	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
AgeingATwork	Psychology/Mental abilities Workability	Domain 1 Domain 2	Transversal	Managers need to be trained in order to implement solutions creating job support for learning and engaging employees in employability activities. However, none of the solutions were described in the dissertation.
Psychosocial Factors Impacting Workplace Injury Rehabilitation: Evaluation of a Concise Screening Tool	Physical ability Workability	Domain 1 Domain 3	Transversal UC3 UC4 UC7	No information on practical ways to improve social support at work. The questionnaire measuring social support, confidence in returning and coping is available for researchers. The questionnaire can be used in every group of injured workers who are waiting to return to work.
Guideline for the Implementation of Human-Oriented Assistance Systems in Smart Factories	Learning, cognitive functions Physical ability	Domain 1 Domain 5	UC1 UC2	Presented guidelines are not a direct solution for older workers, but for organisation's representatives who are interested in guidelines for the implementation of human-oriented assistance systems in smart factories. The advantages of the implementation besides the general assistance of the employee are work flexibilization, competence development of employees and the computerization of the workplace. Employees can change their workstation easily and do a training on the job.
The impact of the working environment on work retention of older workers	Physical ability Psychology/Mental abilities Workability	Domain 2 Domain 3 Domain 4 Domain 5	UC2 UC3 UC4	The authors do not provide quantitative assessment for benefits

	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Additional Leave as the Determinant of Retirement Timing—Retaining Older Workers in Norway	Physical ability Psychology/Mental abilities	Domain 2	UC2	Additional leaves adds to the pros for continuing working, motivating the choice of later exit over early retirement against other factors "pulling" or "pushing" older workers out of work
Older Worker Identity and Job Performance: The Moderator Role of Subjective Age and Self-Efficacy	Psychology/Mental abilities	Domain 1 Domain 2	Transversal	The study has been conducted with reference to the Spanish context and findings may not be transferable to other cultural environments due to the existence cultural differences.
The Employability of Older Workers as Teleworkers: An Appraisal of Issues and an Empirical Study	Physical ability Psychology/Mental abilities Workability	Domain 1 Domain 5	Transversal	The research is agnostic with respect to the industry sectors (study sample included 314 managers from a large variety of companies in the United States).

	Problems addressed	Domain	UCs	Relevant comments for Ageing@Work
Current and future industrial changes: Demographic change and measures for elderly workers in industry 4.0	Learning, cognitive functions Physical ability Workability	Domain 1 Domain 2 Domain 5	UC3 UC4	Describe the results of the application of the best practice in the described environment. Include the number of involved people, and indicators of improvement in the workability (example, Index WAI)
Universal design frameworks for policies in the workplace: Case studies and best practices	Workability	Domain 5	UC3 UC4 UC6	
Lessons learned from the Kronos research project	Psychology/Mental abilities	Domain 2 Domain 3	UC2 UC4	Suitable working time models are one important measure to maintain or even improve the working capacity of older workers.
Siemens locations are OHSAS 18001 zertifiziert	Workability	Transversal	UC3 UC4	Specific Siemens standards
Time4You	Workability	Domain 2 Domain 3	UC2 UC3 UC4	

Developing an Extended Model of the Relation between Work Motivation and Health as Affected by the Work Ability as Part of a Corporate Age Management Approach	Psychology/Mental abilities Workability	Domain 5	UC4 UC6	

4. Overall conclusions of benchmarking

Current technologies have proven their usefulness to support ageing and increase life expectancy and support independently living of the citizen when ageing. Additionally, some of the tools, technologies and application explored within this document have an extended acceptance in population to support fitness and wellbeing activities, as it is the case of wristband and running/exercise applications. This can be appreciated in the great amount of application and tools in the physical activity and wellbeing areas analysed.

There exists an unbalance distribution between the domains principally addressed by best practices, more oriented to domain related with the management or in which the manager role has more importance (i.e. domain 1 and domain 2 and domain 5). Those domains that technology solutions address is more related with the worker and the the physical environment of the work. Therefore, Ageing@Work should face both together in order to real impact on the quality of life of the involved workers, and improve workability and work-life balance.

The next step of this document is to make a combined analysis between the results of this deliverable and the results of the different workshops and co-creative sessions in the pilot sites (ANEFA and Siemens) that are planned to take part in July 2019 and October 2019. A more suitable selection of technologies can be done after a deeply analysis of working environment (including safety and security rules) and the working behaviour of the user, together with the results of preliminary work in technical work-packages.

4.1.1Possible adoption for Ageing@Work project

According to the collected best practices, the engagement and acceptance are two of the main characteristics for success of workability support tools, activities, and technologies. So, considering, the good acceptance of some of the technologies and tools analysed in this document by the general public (i.e. wristband, health support apps), Ageing@Work can take advantage of these extended technologies. The learning curve and the need of training should be minimized since, for workers in general and especially for Ageing@Work planned pilots' workers, the work schedule disposition has to allow regular breaks in order to take part of workability improvement measures introduced by tools, technologies and best practices incorporated in the Ageing@Work system. Augmented reality appears as a good alternative in use cases related with Learning, cognitive functions, and workability problems according to the results of some of the technologies analysed.

Suitable working time models are one important measure to maintain or even improve the working capacity of older workers, as some of the best practices highlighted. Furthermore, stress relieve for employees who care for elderly relatives or children and thus maintains their productivity and decreases

the risk of accidents or negligence in general. Personalization of the models should take into account social and family context in other to better fix the possible solutions and achieve with the proposed objective. The close collaboration with managers is totally necessary for the success of the proposed solution.

Other important issue commonly highlighted in consulted sources is the need of worker are previously interested themselves in a healthy way of living, otherwise, the adherence to the application, advices or activities purposes are very low. Usability and navigability of apps and tools with major acceptance should carefully analysed together the results of the pilots focus groups in order to adapt the user experience of Other important issue commonly highlighted in consulted sources is the need of workers that are previously interested themselves in a healthy way of living, otherwise, the adherence to the application, advices or activities purposes are very low. Usability and navigability of apps and tools with major acceptance should be carefully analysed together with the results of the pilots' focus groups in order to adapt the user experience of our workers to their specific needs. This will be considered during the design of the solution in order to promote the early engagement of both workers and managers within the proposed solutions in the Ageing@Work project.

To facilitate the integration, Ageing@Work should select those that have open APIs to collect data. Vendor independence (enable multiple types and providers of a specific device) in the case of the wristband sensors is a valuable characteristic for our final solution, so connecting these types of sensors, using Google Fit functionalities could be feasible in Ageing@Work system.

Analysed tools, apps, technologies, and best practices might be useful to improve workability of the aged workers, since have the potential to decrease the burden of work-related diseases and early retirement. Most of the applications and tools have been designed for a specific work context, so necessary adaptation should be necessary to be used in specific pilot sites. Evaluation methodology should consider these adaptations to measure the impact of the proposed solution in the results of the project.

Finally, the final design of Ageing@Work solution should be defined according to rules and normative of the specific sector and of the company. For instance, the solution, in case of Siemens pilot should be compliant with the Siemens locations that are OHSAS 18001 certified. This could be a barrier for the installation of commercial devices.

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Annex I: Best practices analysed

General information	Best Practice on motivational approaches
Name of the best practice	Developing an Extended Model of the Relation between Work Motivation and Health as Affected by the Work Ability as Part of a Corporate Age Management Approach
Short description	It aims at developing an extended model of the relation between work motivation and health as affected by work ability and at deriving a host of measures that enterprises can apply as part of a corporate age management policy to counteract the impact of demographic changes.
Covered area/industrial sector	Any corporation.
Promoter	The idea of this best practice was devised by Annemarie Feißel.
Indicative cost	It is a theoretical work, based on different experiences, such as the lidA study (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4276057/)
Problem addressed (explain specifically how addressed the problem)	The authors introduce empirically verified determinants that are seen as highly relevant for introducing and implementing a corporate age management policy. □ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) When work-related stress decreased there is an increase in work motivation and the share of positive health. X Workability Work motivation is not or hardly dependent on age and gender, however, both socio-demographic parameters have a strong impact on a person's work ability and/or health. A person's current occupation plays a decisive role for his/her work ability, work motivation, and health.

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases
	(Good working conditions and a high quality of life at work promote the employees' health, work motivation and work ability and help safeguard the work participation of older employees.)

Need of training to implement the motivational approach or/and the best practice	No training needed.
Results and benefits	It's a model that hasn't been implemented yet. The solution could be a corporate age management program that helps reduce work-related stress on the one hand and on the other maintains and promotes the work ability as well as work motivation and health. Age management means to integrate the age aspect into all business processes and decisions so that employees can enjoy healthy and motivating work until retirement age. It is possible to maintain their work ability by matching their reduced capacities with their job demands.
Applicability limitations	Companies do not always have the necessary competences to implement special measures so that collaboration with different partners may be beneficial. The authors recommend cooperating externally mainly with scientific institutions, consulting institutes, or social insurance agencies.

General information	Best Practice on motivational approaches
Name of the best practice	Development and Evaluation of working time models for the ageing workforce: Lessons learned from the Kronos research project
Short description	Results of the Kronos research project. "*Under ten sub-projects implemented in six German companies from the automobile, steel, pharmaceutical and chemical industries, ageing-appropriate working-time models (e.g. part-time work, short breaks, ageing-appropriate shift work, long-term time accounts) were examined and/or newly developed, introduced and evaluated*" (Knauth P., 2013). Following recommendations have emerged: • A uniform reduction of working hours is not recommended due to the huge diversity among the individuals • Older employees who do hard work shall have the possibility to take frequent breaks • Shift systems based on fast forward rotation should be preferred • Reduce the number of night shifts per person per year • Working-time choice and sabbatical options should be offered
Covered area/industrial sector	Six German companies from automobile, steel, pharma and chemical industries.
Promoter	Kronos Research Project
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) Shift workers may have sleep disturbances. Therefore, shift based on fast forward rotation shall be preferred. X Workability Flexible and individual working time and frequent breaks can enhance workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 2: Increasing job retention (postponing early retirement)
	  • The paper gives recommendations about Individual working-time design that may improve the WAI
	• Domain 3: Improving productivity and workability
	  • Leisure programs hard working older employees shall have the possibility to take frequent breaks
	  • Shift work design has an influence on the WAI

Need of training to implement the motivational approach or/and the best practice	Managers might need to learn that changing the working-time, the shift work design does not automatically decrease the productivity but can increase the WAI of the employees.
Results and benefits	Suitable working time models are one important measure to maintain or even improve the working capacity of older workers.
Applicability limitations	N/A

General information	Best Practice on motivational approaches
Name of the best practice	Siemens locations are OHSAS 18001 zertifiziert
Short description	OHSAS 18001: Identify risks due to accidents or overload in good time and implement effective measures to protect your employees.
Covered area/industrial sector	Siemens AG
Promoter	HR
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability Ensure that risks due to accidents or overload are Identified before issues occur.
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers • Policies to avoid risks and accidents
Need of training to implement the motivational approach or/and the best practice	No training needed.
Results and benefits	Certificate ensures the same standard at all Siemens locations.
Applicability limitations	The number one cause of accidents today is behavioural and organisational shortcomings. These are best combated with a Safety at Work Management System. Companies that have such a system in place are less frequently and less precisely monitored by the supervisory authorities. This is beneficial for both sides. In companies with a works council it is, however, necessary that such an employee representation builds up sufficient competence in internal auditing according to the certificate issued by their company. In the medium term, the frequency of accidents will be reduced, which in turn will lead to fewer downtimes, incidents and disruptions in operations. Commitment and loyalty of the employees, as well as the attractiveness of the company for potential new employees increases. The company can better adapt to the demographic change. Both everyday processes and rare activities must be checked for dangers and risks. Procedural instructions are intended to ensure that legal requirements for

	operations are regularly collected, evaluated and implemented. Goals and programs for the continuous improvement of occupational health and safety must be defined and actively implemented. Training courses are of particular importance for all hierarchy levels. Furthermore, work equipment and appropriate protective equipment must be procured and made available

General information	Best Practice on motivational approaches
Name of the best practice	Siemens health promotion
Short description	Employees and managers are advised and supported to build a: • systematic health management, • health programs to promote physical activity, • healthy nutrition and mental health, • active breaks at the workplace, • training on healthy behavior at the workplace, • health-promoting supporting program, to strengthen our employees
Covered area/industrial sector	Siemens AG
Promoter	HR
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) Health workshops are an integral part of health promotion measures. Health Promotion systematically advises and supports employees and managers with programs in the areas of e.g. mental health. X Workability Health Promotion systematically advises and supports employees and managers with programs in the areas of physical activity promotion, a healthy working environment, nutrition.

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity
	  • Leisure and sleep educational programs
	  • Vacuums and medical check (early prevention programs)

Need of training to implement the motivational approach or/and the best practice	A certain number of employees (HR, managers, or employees) have to be trained to lead such activities or professional services have to be engaged; all employees have to be motivated to participate and stay with the program. If a cafeteria is part of the company healthy food has to be offered at the same price or even les to motivate employees. Regular advertisement of all measures is essential.
Results and benefits	Health workshops support the employers to stay healthy and active.
Applicability limitations	Especially for factory workers, the work schedule disposition has to allow for regular breaks in order to take part in such activities; employees in general have to be interested themselves in a healthy way of living.

General information	Best Practice on motivational approaches
Name of the best practice	Time4You
Short description	Time4You enables employees to take additional days off and thus creates space and flexibility for individual time planning.
Covered area/industrial sector	Siemens AG
Promoter	HR
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability Provide additional days off to support the work life balance of the employees.

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 2: Increasing job retention (postponing early retirement)
	  • improve the WAI through Individual working-time design
	• Domain 3: Improving productivity and workability
	  • Employees that are well recovered have a higher WAI

Need of training to implement the motivational approach or/and the best practice	Employees have to be made aware of the program, the benefits and reasons behind the program e.g. time to take care of elderly relatives, stress relieve for older employees, take care of children, etc.
Results and benefits	Suitable working time models are one important measure to maintain or even improve the working capacity of older workers. (see Kronos Research Project). Furthermore, stress relieve for employees who care for elderly relatives or children and thus maintains their productivity and decreases the risk of accidents or negligence in general.
Applicability limitations	The implementation of such a program depends on the size of the company, number of employees and the corporate social responsibility for the wellbeing of employees.

General information	Best Practice on motivational approaches
Name of the best practice	Current and future industrial changes: Demographic change and measures for elderly workers in industry 4.0
Short description	Future work activities, the demographic challenge, age-related changes of human work ability and the role age-appropriate work design and standardization as well as assisting can play to enable elderly workers for the future industrial work setting, based on a study conducted in Austria in 67 industries of various sectors. The following measures and possible solutions for age-appropriate working have been evaluated: as most important by participants of the study, from higher to lower importance: • Technological support and relief of workstrain (95%) • Age-appropriate workplace design (86%) • Implementation of smart production technologies (86%) • Age-related qualification programs (e.g. lifelong learning) • Age-related career development (77%) • Reduce costs for older employees (77%) • Use of assistance systems in production (75%) • Age-appropriate standards and working norms (52%)
Covered area/industrial sector	Various
Promoter	Matthias Wolf, Technical University of Graz, Institute of Innovation and Industrial Management, Kopernikusgasse 24/2, Graz, Austria, matthias.wolf@tugraz.at
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions Assistance systems, ICT and physical support through robotics and automation can enable elderly workers to perform to their potential and compensate for cognitive impairments. ☐ Sensory ability X Physical ability Assistance systems, ICT and physical support through robotics and automation can enable elderly workers to perform to their potential and compensate for physical impairments. ☐ Psychology/Mental abilities (including sleep problems) X Workability Age based working methods, work- and workplace design (86%) and skill-based work division between humans with different abilities or humans and machines can be means to adapt work to human conditions. Providing a suitable occupational education system to equip the workforce with the right qualifications and skills and an age. Appropriate human resource management are important factors to keep workers efficiently in employment

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 1: Policy for older workers
	  • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

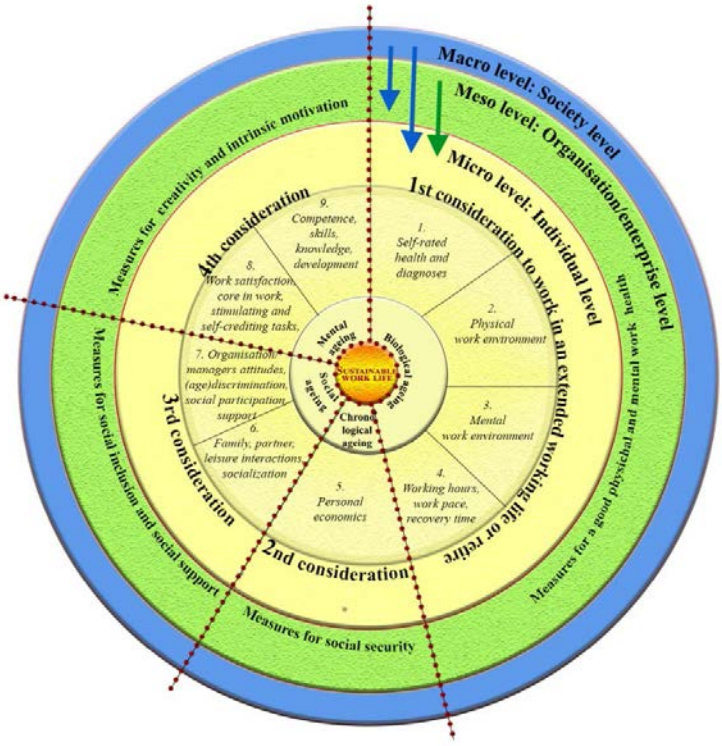
Need of training to implement the motivational approach or/and the best practice	It cannot be answered as the paper does not refer to specific technologies but to a variety of best practices which entail all different levels of training needs.
Results and benefits	a) Support for physical work: reinforce the physical abilities and lower the physical work-related strain, reinforce impaired ability to move parts of the body, avoid health risks by lower physical under or overload, increased occupational safety, avoiding risks in human-machine interaction, adapt signals and warning signs to workers' physical characteristics b) Support for cognitive work: Visualizing alternative decisions that take into account human information processing in order to reduce biases in decision-making, lower required short-term memory effort by visualizing detailed on-demand information, suggesting breaks to work, in order to ensure concentration, lower the amount of errors made on the shop floor by real-time observation of the process and skill- and ability based work instructions, supporting continuous professional training and learning
Applicability limitations	N/A

General information	Best Practice on motivational approaches
Name of the best practice	Universal design frameworks for policies in the workplace: Case studies and best practices
Short description	Universal design is used to establish spatial requirements and physical guidelines to benefit all users to the extent possible, with similar goals as the industrial/ human factors engineering and safety profession. The purpose of the study is to explore and document factors that were hypothesized to lead to successful implement of workplace policies that for addressing the physical, psychological and social needs of a workforce with diverse abilities. The most important factors, as evaluated by participants were: • SMD and UD adoption • Establish Executive level backing • Provide UD expertise • Provide enabling resources • UD as a priority on the agenda • Make UD a shared task
Covered area/industrial sector	Electrical construction industry, plastics manufacturing industry, human services industry
Promoter	Cassandra Kern, Department of Industrial Systems and Engineering, Faculty of the Graduate School of the University at Baffalo, State University of New York
Indicative cost	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability: Universal design enables the adaptation of a workplace to the widest types of workers

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to implement the motivational approach or/and the best practice	Human factors engineers and safety professionals, along with universal designers can implement the principles of universal design in workplaces.

Results and benefits	Nine people were interviewed in total, 3 from each industry (Electrical construction industry, plastics manufacturing industry, human services industry). Universal design enables the access of a workplace to the greatest extent possible by all people regardless their age, size, ability or disability. This makes the workplace more efficient and safer for workers.
Applicability limitations	N/A

General information	Best Practice on motivational approaches
Name of the best practice	The impact of the working environment on work retention of older workers
Short description	The source of this analysis is a Report from the Fafo Institute for Labour and Social Research in Norway, which surveys existing literature evidence regarding working environment factors that impact work retention of older workers (the work is part of a wider effort that include three other Nordic countries: Sweden, Denmark and Iceland). Reviewed studies are based on large-scale datasets from surveys (both cross-sectional and retrospective cohort studies), register data, longitudinal studies and qualitative studies. Main outcomes considered in the studies are labour market exits due to disability pension, sickness absence, and voluntary early retirement (in particular through AFP, a Norwegian voluntary early retirement scheme introduced in 1988). In general, the Report concludes that the Norwegian labour market participation and retirement behaviour among older workers are affected by a multitude of factors at the macro, meso and micro level (see figure below).  They include factors not related to the work environment, such as labour market situation, including the business cycle, downsizing and unemployment, financial incentives and other features of the pension system and social insurance system, social position (sex, educational level and occupational position), gender, civic status, spouse's labour market

situation and retirement, and (to a lesser degree) caring responsibilities. However, health, work ability and work environment seem to be among the most important factors.

The following table summarizes work environment factors and reports the strength of related evidence (the evidence assessment depends on the results of the overall research, which includes the other 3 Nordic countries, although the table only lists factors investigated in Norwegian studies). Greyed factors represent macro-categories.

Work factor	Strength of evidence
Occupational accidents	The association between occupational accidents and disability retirement is well-documented.
Chemical work factors	
Air pollutants, Exhaust fumes	One study shows a strong association between disability pension and exhaust fumes. However, due to the low number of studies, the association is uncertain.
Cleaning agents and disinfectants	One study finds associations between sick leave and occupational skin exposure to cleaning products and waste among men, and water among women. However, due to the low number of studies, the association is uncertain.
Physical work factors	
Whole-body vibration	Two good quality studies show a strong association with exit to disability pension.
Noise	Uncertain. Only one inconclusive study.
Strenuous work – high physical work demands	In general, the studies show a strong association between high physical work demands and retirement (both disability retirement and voluntary early retirement). The most frequently reported work factors are: • Strenuous work • Heavy/awkward lifting • Repetitive work • Work with hands lifted • Prolonged standing.
Psychosocial work	For some psychosocial work factors, the studies show conflicting results
Job control / autonomy / influence at work	Low job control/autonomy is strongly associated with disability retirement and voluntary early retirement in several studies.
Job satisfaction	Low job satisfaction is associated with disability retirement and voluntary early retirement.
Shift work	Shift work does not contribute to gender difference in disability retirement. However, the association is uncertain.

	Psychological work demands (work speed, time pressure, emotional demands)	Psychological work demands are risk factors for early voluntary retirement.
	Leadership support/quality	Low leadership support is associated with disability retirement and early voluntary retirement.
	Poor colleague fellowship / support	Poor colleague fellowship/support is a risk factor for disability retirement. However, the association is uncertain.
	Possibility for competence development	One study finds that high possibility for competence development predicts low transition to disability pension. However, the association is of moderate certainty.
	Fear of reorganisation	Fear of reorganisation is a risk factor for disability retirement. However, the association is uncertain.
	Conflicts at work/ bullying/harassment	A study found bullying/harassment to be a non-significant risk factor for disability retirement.
	Age discrimination	Several reports document the existence of age discrimination. The most prominent effect of age discrimination is that older workers have very limited possibilities to get a new job if they become unemployed, and therefore often are forced to take early retirement.
Covered area/industrial sector	The Report is general and covers several industry sectors as well as work in public and private organizations. One important remark from the Report is that although research has shown that the causes of early retirement are complex and are generated by a number of different factors within, as well as, outside the workplace, which would lead to assume that, in order to be effective, the initiatives and instruments launched to prevent early retirement need to vary between professions, industries, and sectors, in Norway they generally do not. The options and the allocation criteria are surprisingly similar across industries and enterprises, despite the heterogeneity of needs, problems, and challenges. The authors conclude that this may be one reason why active aging policies and the measures chosen by Norwegian companies are not necessarily effective in reducing early retirement.	
Promoter	Tove Midtsundstad, Ingrid Sivesind Mehlum and Anne Inga Hilsen; Fafo Institute for Labour and Social Research, Norway; DOI: 10.13140/RG.2.2.24869.91368	
Indicative cost	The authors do not offer quantitative estimations of involved costs. However, they conclude in general that the costs of the measures offered by Norwegian organizations may exceed the intended gains, as those who	

	would continue working anyway also are entitled to the retention measures.
Problem addressed (explain specifically how addressed the problem)	In the following, relevant results from the surveyed studies are reported for each of the indicated problem categories. X Learning, cognitive functions • [see section on "Need of training to implement the motivational approach or/and the best practice"] □ Sensory ability X Physical ability • Mechanical exposures tend to be lower in the oldest group, but not consistently among women; having to stand (for three quarters of the workday) and heavy lifting (20 kg or more) at work is more common among 55- to 67-year-old women than among the 35–44 and 45–54 age groups. • Findings indicate that disability retirement is related to physical job strains, particularly musculoskeletal and cardiovascular disability, which might indicate a mismatch between the physical capabilities of older workers and physical job demands. • Having a heavy workload (self-reported) increased the probability of drawing an AFP pension early, when other relevant factors were controlled for. It has been also found that many retirees themselves, especially blue-collar workers, related their early retirement to heavy workloads X Psychology/Mental abilities (including sleep problems) • Older workers seem to encounter fewer demands at work, but also receive less support and feedback from their supervisors. • Psychological job demands are generally somewhat reduced with age, and low job control is somewhat more frequent among the older employees, compared to the middle-aged. • Among men, early retirement is related to low autonomy in job tasks and cardiovascular disability. Furthermore, psychological job stress was associated with lower non-disability retirement. X Workability • Physical and ergonomic work environments are often better among older workers than among younger workers. This may be due partly to selection (i.e. the "healthy worker effect", as a result of earlier retirement among workers with poor work environments leading to poor health) and partly an effect of adaptions and shifts to less demanding jobs with age, often with foreman or leadership responsibilities • It has been found that monotonous work, prolonged standing, neck flexion and whole-body vibration appeared to be the most consistent and important predictors of work disability
Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies

	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4 Healthy habits programs
	  • Physical activity
	  • Vacuums and medical check (early prevention programs)
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to implement the motivational approach or/and the best practice	The authors report that surveyed studies have found that: • Time associated with training new staff is correlated with efforts to retain older workers in Norway. Thus, for companies where the training of new staff requires substantial time, retaining experienced workers will presumably be desirable. • Participation in learning activities declines with age, as older workers see less opportunity for learning new things at work (although less so than in the EU: in 2008, EU27 had a participation rate for older workers aged 50 to 64 of 9.5, while Norway had a rate of 19.3). As opportunities for learning may contribute to maintained work ability, measures to include older workers in training and learning may contribute to improved work ability • In particular, when the workplace does not require older workers to change their job tasks, this gives rise to a feeling of why bother to engage in training • The relevance of the training on offer is often an issue for older workers. Older workers have broader perspectives, greater understanding and sounder judgements than their less experienced counterparts. Thus, they tend to be more critical consumers of training products. The balancing and contemplation often takes place between what is their current situation and what could it be after taking more training • Older workers retiring on AFP at age 62 related their early retirement to the introduction of new technology and/or employer demand for further workplace training, which they did not want to take part in. In particular, about 30 % of the early private sector retirees and about 20 % in the governmental sector related their retirement to either the introduction of new technology or demand for further training
Results and benefits best practice	The authors do not provide quantitative assessment for benefits. However, they generally conclude that different qualitative studies of the relationship between work time reductions, extra days off, bonuses etc. on expected and actual retirement age fail to find any clear indications of the effect of such interventions on retirement behaviour, although all these interventions are highly appreciated by the older workers receiving them. In addition, several studies, based on combined survey and register data (2001–2007/2010) have analysed whether work place interventions actually

	offered by Norwegian companies have any effect on sickness absence, disability pensioning and/or voluntary early retirement behaviour, using either a difference-in-differences approach or a fixed-effect approach (natural experiment). The authors conclude from such studies that, although being offered a retention measure per se did not seem to have any effect on the retirement behaviour, some of the retention measures offered seem to have an impact on the retirement behaviour, if not for all groups of employees, then at least for some. Furthermore, three different studies, investigating the effect of being offered different work place interventions to reduce sickness absence and disability, found that work-related measures offered by Norwegian companies to prevent further injury and exhaustion among employees with reduced working capacity did not reduce sickness absence probability or sickness absence duration per year among older workers, although they did reduce the likelihood of disability pensioning among workers over 50. One reason for this may be that adjustments of working conditions make it easier for people with health problems to continue working, which reduces disability rates. At the same time, people with health problems will have higher probability of sickness absence, so the sickness absence rates will increase.
Applicability limitations	The study specifically refers to the Norwegian context (although it has been conducted in the frame of a larger endeavour that also include Denmark, Sweden and Iceland, which concluded that evidence from all these Nordic countries is consistent). In addition, the Report acknowledges that more research is needed to investigate the following: • Labour market mobility among older workers, to better understand how rehiring and recruiting processes affect older workers' labour market participation • How different age management strategies and programmes, as well as work-place interventions, affect retirement behaviour and labour market participation. • Application of mixed-methods (i.e. interdisciplinary studies combining register and survey studies with case studies and other forms of qualitative data). Although advanced econometric or epidemiologic analyses based on register (panel) data are the best way to document causal evidence, they often fail to explain the "how" and "why". • Consider additional, important—and, especially, new and forthcoming—factors, which are not registered in administrative registers.

General information	Best Practice on motivational approaches
Name of the best practice	Additional Leave as the Determinant of Retirement Timing—Retaining Older Workers in Norway
Short description	The analysis uses a difference-in-differences approach and examines whether offering additional leave (five days or more) to counteract early retirement, impacts the retirement decisions of 61- and 62-year-olds within the next two years of their employment, controlling for a range of different individual and company characteristics. This is achieved by comparing changes and differences in the individual relative risk of retiring early on the contractual pension (with the contractual early retirement scheme AFP) in the period 2001–2010 among older workers in Norwegian companies with and without the retention measure. The analysis shows an overall average increase in the relative risk of a 61- or 62-year-old worker retiring on the contractual pension between 2001 and 2010; however, among older workers employed in companies offering additional leave there has been a decrease in the relative risk. The effect of additional leave is evident both before and after controlling for the selected individual and company characteristics. Thus, the analysis shows that offering additional leave as a retention measure reduces the individual relative risk of withdrawing a contractual pension (AFP) in the next two years of employment among older workers between the age of 61 and 62 years.
Covered area/industrial sector	The type of industry has been proven to influence whether older workers make an early exit from working life. To account for this differences, the model used by the author controls for the following industry sectors: • Public administration • Teaching • Health and social services • Manufacturing • Construction • Hotels and restaurants • Wholesale and retail trade • Other industries
Promoter	Åsmund Hermansen, Researcher, Fafo Institute for Labour and Social Research, Norway DOI: 10.19154/njwls.v4i4.4709
Indicative cost	The author does not offer quantitative estimations of involved costs. However, a first approximation of the cost can be easily computed as the monetary burden associated with the additional paid leaves. Nonetheless, the author cautions that the cost of the measure must be weighed against the benefits associated with an extended working life. If, for example, the effect is driven more by a "social signal" helping to counteract an "early exit" regime (i.e. the company offering the measure signals that it values older workers and wish that they continue working), rather than by the availability of more leisure time, other less expensive measures may have the same effect on the individual risk of retiring early.

Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability • "pull factors" related to decreased physical ability, may be addressed by the best practice (see next bullet) X Psychology/Mental abilities (including sleep problems) • The best practice may act along two dimensions o It can impact on "pull factors", which "pull" the older worker towards voluntary exit. In particular, the practice intervene on the balance of preferences between the desire for more leisure time and the one for financial stability. For an individual desiring to maximize lifetime earnings as well as more leisure time, being offered additional leave represents a new opportunity to gain more leisure while continuing paid employment. Besides, such measure also signals the employer's wish for older workers to continue working in the company, acting as an additional motivating factor. o It can impact on "push factors" that involuntarily "push" the older worker out of work. For example, offering additional leave in the final phase of working life may help older workers to reconcile work and the need for more leisure, reducing the burdens that typically "push" them out of working life early (e.g. physical and mental strains related to the job). □ Workability
Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
Need of training to implement the motivational approach or/and the best practice	No training is required to apply the measure.
Results and benefits best practice	Additional leaves adds to the pros for continuing working, motivating the choice of later exit over early retirement against other factors "pulling" or "pushing" older workers out of work. Studies among both employers and employees show that both groups deem additional leaves an effective retention measure.
Applicability limitations	Although studies show that offering additional leaves is a widespread retention measure among employers in many European countries, the results of this work are specifically relative to the Norway context, for 61yo or 62yo workers. This has to be taken into account before generalizing the results.

General information	Best Practice on motivational approaches
Name of the best practice	Older Worker Identity and Job Performance: The Moderator Role of Subjective Age and Self-Efficacy
Short description	The authors analyse the concept of "older worker identity" (hereinafter, OWI). This is the term used to designate the extent to which a worker identifies with the older workers group and the consequent internalization of stereotypes and negative attitudes toward older workers by the older workers themselves. OWI is accompanied by the acceptance of negative characteristics of oneself, such as resistance to change, poor performance, or low work motivation. It is a proven fact that identification promotes the probability of acting consistently with the category with which the person is identified, so OWI can be an antecedent of undesirable behaviors, such as the decline in performance at work. In particular, studies have found positive and statistically significant relationships between OWI and intentions of early retirement. Moreover, the authors show that OWI is negatively related to task performance. Also, they show that the relationship of OWI with task performance is moderated by subjective age (subjective age refers to how young or old an individual perceives himself. Subjective age includes various components, such as the age people feel, their apparent age, the desired ideal age, and the age of the most similar people in terms of tastes, interests, and behaviors). However, the influence of subjective age on OWI is counterintuitive: when workers perceive themselves as older, the negative effect of OWI on performance is lower. Workers may perceive their own OWI, involving the generalized idea of "reduction" of capabilities, but they may refuse to accept that this reduction affects them, and they may implement a series of responses to alleviate the potential deficit caused by age. In relation to OWI, it can trigger an attributive process, for example, to disease, which serves to alleviate the negative effects on performance. Thus, stereotypes would not have the same impact for all groups but would vary depending on the individuals' behaviors developed to face with negative stereotyping. In other words, when people maintained the characteristics of older workers' stereotypes and they could account for them in their own self-perception as older people, their work performance was somewhat protected from reduction. This provides evidence about the importance of how workers within the company feel, represented herein by the role of OWI, beyond the mere objective conditions of the post. In this sense, if organizations want to prolong the working life of their employees, they should pay special attention to their workers' appraisals, especially those of the older workers, because a climate for successful aging favors the individual application of strategies to alleviate the negative effects associated with age.

	The conclusion is that organizations should pay special attention to their older workers' appraisals. In particular, interventions to teach older workers alternative ways of dealing with new problems that arise in their jobs can improve and reduce the negative impact of aging on organizational outcomes. For example, a cognitive intervention that highlights the positive aspects of older people versus the negative aspects and that enhances generational diversity can have a positive impact on outcomes. Promotion of organizational identification that unites all the members of the company, regardless of age, may be a simple and effective means to ensure the survival of the company and the extension of the working life of its members. Interventions could also focus on subjective age to offset the decline in performance.
Covered area/industrial sector	In principle, the work is agnostic with respect to the industry sector. However, the sample used to conduct the study had this composition: 18% worked in service companies, 11% in the energy sector, 10% in tourism, 7% in education or health, and the rest was distributed in various occupational areas.
Promoter	Francisco Rodríguez-Cifuentes (Department of Medicine and Surgery , Psychology , Preventive Medicine and Public Health, Immunology and Medical Microbiology , Nursing and Stomatology , Rey Juan Carlos I University , 28300 Aranjuez, Madrid,Spain; francisco.rcifuentes@urjc.es) Jesús Farfán (Health Psychology Program, International School of Doctorate, National Distance EducationUniversity (UNED); 28040 Madrid, Spain; jfarfandiaz@gmail.com) Gabriela Topa (Department of Social and Organizational Psychology , National Distance Education University (UNED),28040 Madrid, Spain, gtopa@psi.uned.es; Tel.: +34-91-398-8911) https://doi.org/10.3390/ijerph15122731
Indicative cost	The authors do not provide information about the cost of the proposed coaching initiatives.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) • The authors propose coaching interventions that target older workers' self-appraisals, such as OWI and subjective age □ Workability
Domain/type of solution	• Domain 1: Policy for older workers • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.

	• Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies
Need of training to implement the motivational approach or/and the best practice	The authors propose a best practice based on relevant coaching interventions, targeting OWI and subjective age of older workers to improve their engagement and motivation.
Results and benefits	Fostering the improvement of self-perceptions like subjective age and OWI, through training in observation of the positive features, can lead to older workers' continued engagement, ultimately improving both motivation and task performance.
Applicability limitations	The study has been conducted with reference to the Spanish context and findings may not be transferable to other cultural environments due to the existence cultural differences.

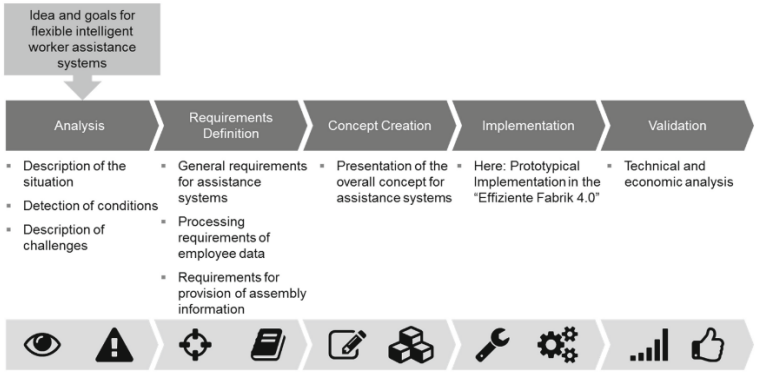
General information	Best Practice on motivational approaches
Name of the best practice	The Employability of Older Workers as Teleworkers: An Appraisal of Issues and an Empirical Study
Short description	The study examines the prospects for the employability of older workers as home-based teleworkers. This alternative type of work could accommodate many of the needs and preferences of older workers and at the same time benefit organizations. However, before telework can be considered a viable work option for many older workers there are a number of issues to consider, including the ability of older workers to adapt to the technological demands that are typically associated with telework jobs and managerial attitudes about older workers and about telework. Through an integrated examination of these and other issues, the study aims at providing a comprehensive understanding of the challenges associated with employing older workers as teleworkers, as well as to present managers' perceptions of worker attributes desirable for telework and how older workers compare to younger workers on these attributes. The study results in a mixed picture with respect to the employability of older workers as teleworkers, and strongly suggests that less experienced managers would be more resistant to hiring older people as teleworkers. The authors provide recommendations that employers may follow to improve the prospects for employability of older teleworkers: • Educate managers to look past common myths concerning the abilities and tendencies of older workers • Better map out the types of work activities that can be performed as telework and, especially for companies in the private sector, establish programs dedicated to creating, managing, and assessing telework • Provide the instructional vehicles that would enable older workers to become trained in the relevant technologies • Provide the necessary coaching and feedback for older workers to successfully perform their jobs while working exclusively from the home • Give greater consideration to workspace design factors to which older people (as compared to younger workers) may be more sensitive
Covered area/industrial sector	The research is agnostic with respect to the industry sectors (study sample included 314 managers from a large variety of companies in the United States).
Promoter	Joseph Sharit (Department of Industrial Engineering, University of Miami, Coral Gables, FL 33124, USA) Sara J. Czaja (Department of Psychiatry and Behavioral Sciences, University of Miami Miller School of Medicine, Miami, FL 33136, USA) Mario A. Hernandez (Center on Aging, University of Miami Miller School of Medicine, Miami, FL 33136, USA)

	Sankaran N. Nair (Center on Aging, University of Miami Miller School of Medicine, Miami, FL 33136, USA) DOI:10.1002/hfm.20138
Indicative cost	The authors do not provide quantitative assessment of costs involved in employing older workers as teleworkers. However, they mention that investment is needed in the following directions: • Set up the appropriate ICT infrastructure • Training older workers in the ICT-related skill they need to be effective in using teleworking tools • Training older workers with respect to specific, possibly new, tasks amenable to teleworking
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability • Burdens associated with commuting to work are eliminated X Psychology/Mental abilities (including sleep problems) • More flexibility in managing part-time work and work-leisure balance X Workability • Enhanced security that comes with working from their homes, if workers have health or other personal issues that can be better managed in these environments

Domain/type of solution	• Domain 1: Policy for older workers
	  • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to implement the motivational approach or/and the best practice	Training is likely to be necessary to: • Learn ICT technologies which may include, e.g. handheld wireless devices or desktop video conferencing equipment, or may require sophisticated Internet information-seeking skills • Acquire the skills needed to perform less routine and more complex problem-solving telework tasks
Results and benefits	For employers, benefits include an increased labor pool (to include older people and people with disabilities) and enhanced recruiting potential; improved retention of qualified staff; less sick leave and absenteeism; reduced costs for office space and parking; heightened productivity (due to fewer interruptions and better concentration); improved (due to extended) customer service; and improved organizational image (e.g., in promoting a better environment). On the other side, concerns for organizations include negative effects on

	organizational culture, reduced loyalty, reduced tacit knowledge transfer, and negative impacts on activities requiring teamwork, all by virtue of the loss of socialization aspects of the workplace and reduced professional interaction; increased difficulty in monitoring and assessing employee performance; needed investments in ICTs; less control over data security; and less control and greater ambiguity with respect to legal issues governing work at home, such as worker injuries or health risks. From the perspective of the employee, benefits include a reduction or elimination of the (often stressful) work commute; fewer distractions and improved concentration; increased satisfaction (due to increased autonomy and control over how the work is done); the ability to accommodate disabilities or mobility problems; better opportunities for part-time work; and an enhanced ability to balance work life with family or personal responsibilities and needs. The concerns for teleworkers include isolation and separation (the effects of which are highly variable among individuals); distractions that can arise within the home; and the perceived pressure on the part of the teleworker to be "visible" (which may result in resorting to overwork, e.g., in the form of frequent checking of e-mail).
Applicability limitations	The most obvious limitation, mentioned by authors, is that not all jobs are suitable for telework—tasks that require face-to-face communication or interfacing to equipment or systems located at the organization's primary work site clearly would not be amenable to telework.

General information	Best Practice on motivational approaches
Name of the best practice	Guideline for the Implementation of Human-Oriented Assistance Systems in Smart Factories
Short description	The guideline developed in this paper provides an orientation and basis for the company-internal discussion during the introduction of new assistance systems in assembly.
Covered area/industrial sector	The central goal of this implementation concept is to provide the employees with the help of a socio-technical design approach using Industry 4.0. The advantages and opportunities include, in particular, the flexibilisation of the work, the computerization of the workplace, the competence development of the employees and the assistance of the employees. The methodology of the company-specific implementation of flexible and intelligent worker assistance systems is divided in five primary phases, as shown below:  **Fig. 1.** Methodology for the implementation of worker assistance systems During the analysis phase the initial *status quo* is documented and the basic conditions are evaluated. The second phase is used for the definition of requirements, which is an essential part for a successful and company-specific implementation. In the following phase the concept is created, which includes especially the documentation and processing of personal data. During the implementation phase the company-specific concept is implemented by the project team with the help of specialists. The process ends with the validation phase, when the implementation results are tested and, if necessary, optimized.
Promoter	It is not a ready-to-use tool. Contact to guidelines' authors: Alexander Arndt arndt@dik.tu-darmstadt.de
Indicative cost	Depending on the solution to be implemented.
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions - The main aim of the implementation of human-oriented assistance systems is to provide the employee with customized help, including competence development and computerization

	of the workplace. □ Sensory ability X Physical ability - The main aim of the implementation of human-oriented assistance systems is to provide the employee with customized help, including more flexible working conditions, improving ergonomics, enabling new activities and age-based work organization. □ Psychology/Mental abilities (including sleep problems) X Workability – It includes, in particular, the flexibilisation of the work, the computerization of the workplace, the competence development of the employees and the assistance of the employees.
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers • Domain 5: Adaptation and compensatory mechanisms
Need of training to implement the motivational approach or/and the best practice	Presented guidelines are not a direct solution for older workers, but for organisation's representatives who are interested in guidelines for the implementation of human-oriented assistance systems in smart factories.
Results and benefits	The advantages of the implementation besides the general assistance of the employee are work flexibilisation, competence development of employees and the computerization of the workplace. Employees can change their workstation easily and do a training on the job.
Applicability limitations	The guidelines are quite general so can be adopted to any smart systems implementation. However, motivation of older employees is not mentioned.

General information	Best Practice on motivational approaches
Name of the best practice	AGINGAT WORK: The moderating role of age in occupational wellbeing – PhD dissertation written by Paola Dordoni
Short description	The PhD dissertation presents studies proving that employability is an important factor in the older workers' intention to retire process, and in order to motivate older workers to engage in employability activities and work longer, age stereotypes need to be combated. However, in the view of generating a future time perspective in managing employability of both older age groups (55-60, 60+), creating job support for learning over the life stage is also increasingly important.
Covered area/industrial sector	Italian financial institution. 2,082 workers aged 55 years and over participate in an online survey conducted by the company's intranet.
Promoter	Scientific Advisor: Prof. Piergiorgio Argentero; UNIVERSITÀ DEGLI STUDI DI PAVIA
Indicative cost	Not applicable
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) – in the dissertation, problem of employability, motivation and intention to retire was addressed which is related to psychological abilities X Workability – in the dissertation, problem of employability, motivation and intention to retire was addressed which is related to workability issues

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 1: Policy for older workers
	  • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies

Need of training to implement the motivational approach or/and the best practice	Managers need to be trained in order to implement solutions creating job support for learning and engaging employees in employability activities. However, none of the solutions were described in the dissertation.

Results and benefits	Describe the results of the application of the best practice in this environment. Include the number of involved people, and improvement indicators in the workability (example, Index WAI). It was not an application of the best practice, but only the measurement of various factors by means of questionnaire survey and conducting statistical analysis. Nonetheless, relationship between employees engagement in the employability activities and their intention to retire was observed. Moreover, age stereotypes were related to lower engagement in employability activities, and creation of job support for learning in the organisations was important for managing employability of older workers.
Applicability limitations	Not applicable

General information	Best Practice on motivational approaches
Name of the best practice	Psychosocial Factors Impacting Workplace Injury Rehabilitation: Evaluation of a Concise Screening Tool
Short description	The aim of the study was to determine whether the delayed recovery, often observed in simple musculoskeletal injuries occurring at work, is related with poor workplace and home social support. Four question psychosocial screening tool called the "How are you coping gauge?" (HCG) was developed (Questions: How well are you coping with your symptoms? How supported do you feel by your workplace, co-workers and managers? How safe and supported do you feel by your family, friends and finances? How confident are you that you will return to your normal work duties?). This tool was implemented as part of the initial assessment for all new musculoskeletal work-place injuries.
Covered area/industrial sector	Patients of three Corporate Health Group (CHG) physiotherapy locations, suffering from simple musculoskeletal injuries. Patients came from a wide variety of occupational areas with varying degrees of physical job demands, ranging from customer service officers to manual labourers.
Promoter	Sareen McLinton; smclinton@chg.net.au
Indicative cost	The questionnaire is free to use. Practical ways for social support improvement were not a part of this research study so best practice in this area remain unspecified.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – the aim of the study was to determine whether delayed recovery from MSDs is correlated with poor workplace and home social support, implicating that social support (especially workplace social support) is related to recovery from MSDs. The tool for social support, confidence in returning and coping measurement was developed. □ Psychology/Mental abilities (including sleep problems) X Workability – Social support, measured with HCQ questionnaire, is correlated with time of recovery from MSD. It means that social support (especially workplace social support) increases workability of injured employees.
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers (no practical tools presented except for questionnaire measuring social support, confidence in returning and coping) • Tools and technologies aimed at improving interpersonal

	communication between the latter and other workplace workers.
	• Domain 3: Improving productivity and workability (no practical tools presented except for questionnaire measuring social support, confidence in returning and coping)
	  • Physical activity programs tools
	  • New therapies Yoga, Taichi, Mindfulness
	  • Leisure programs

Need of training to implement the motivational approach or/and the best practice	No information on practical ways to improve social support at work. The questionnaire measuring social support, confidence in returning and coping is available for researchers.
Results and benefits	A correlation was observed between delayed workplace injury recovery and poor perceived workplace and home social support. Path analysis found workplace support to be a significant moderate-to-strong predictor of number of days until return to full capacity (DTFC). The HCG may be an effective tool for identifying these factors in musculoskeletal workplace injuries of a minor patho-physiological nature. As this was a cross-sectional study improvement in DTFC as an effect of workplace support could not be observed. The tool was tested among 254 patients from a wide variety of occupational areas with varying degrees of physical workload, from customer service officers to manual labourers.
Applicability limitations	The questionnaire can be used in every group of injured workers who are waiting to return to work.

General information	Best Practice on motivational approaches
Name of the best practice	Ergonomics and Demographics @ Continental AG Professionally and scientifically supported by *Institute of Occupational Health, Safety and Ergonomics (ASER) e.V. and Scientific and Technical Consulting Ltd. (GEWITEB)*
Short description	Continental provides attractive and ergonomically designed work places at which employees: • stay healthy in the long-term • have a higher productive efficiency because of less work fatigue • don't make mistakes caused by physical overload and decreasing attentiveness • stay productive in the long-term • will be productive independent of age • will be productive independent of gender Prevention instead of rehabilitation! • Systematic description and ergonomic (risk) assessment of all shop floor (blue collar) workplaces with BAB/BDS-System (see *Application BAB-BDS)* • Establishment of ergonomics teams in each plant; teams are responsible for assessing and analysing exposure and (re)designing workplaces. • Prospective ergonomic assessment is now required during the design and purchasing processes for all new workplaces. • Company-wide provision of information, work aids and a good-practice database to share knowledge. • Systematic training of relevant operational stakeholders • Regular execution of network meetings for the exchange of experience Provision of the BAB / BDS-System as well as expert support in the implementation and execution of training courses by experts of the *Institute of Occupational Health, Safety and Ergonomics (ASER) e.V. and Scientific and Technical Consulting Ltd. (GEWITEB)*
Covered area/industrial sector	All shop floor (blue collar) workplaces at Continental Industrial sectors: • tire manufacturing • electronics manufacturing • metal processing

	• and many more
Promoter	Continental AG (https://www.continental-corporation.com): Joerg Nimoth, Head of Global Ergonomics Rollout Project, Continental AG Contact via: Institute of Occupational Health, Safety and Ergonomics (ASER) e.V. Corneliusstrasse 31 42329 Wuppertal Germany Mail: info@institut-aser.de Internet: www.institut-aser.de Scientific and Technical Consulting Ltd. (GEWITEB) Corneliusstrasse 31 42329 Wuppertal Germany Mail: info@gewiteb.de Internet: www.gewiteb.de
Indicative cost	No information available
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions X Sensory ability X Physical ability X Psychology/Mental abilities (including sleep problems) X Workability Through the described holistic approach all mentioned areas are addressed.

Domain/type of solution	• Domain 1: Policy for older workers
	  • Age- and ageing-appropriate work design
	  • Fitting the task to the operator
	  • reallocate people to more suitable jobs
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Company-wide provision of information, work aids and a good-practice database to share knowledge.
	  • Systematic training of relevant operational stakeholders
	  • Increasing job retention through humane work design
	• Domain 3: Improving productivity and workability
	  • Improving productivity and workability through humane work design
	  • Improving productivity and workability optimal use of skills and abilities

	• Prevention instead of rehabilitation!
	• Domain 4 Healthy habits programs
	  • Supporting the approach through occupational health management
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to implement the motivational approach or/and the best practice	Approach requires elaborate implementation and extensive training of stakeholders involved. A concept for this was developed by Continental AG in cooperation with Institute ASER. Provision of the BAB / BDS-System as well as expert support in the implementation and execution of training courses by experts of the *Institute of Occupational Health, Safety and Ergonomics (ASER) e.V. and Scientific and Technical Consulting Ltd. (GEWITEB)*
Results and benefits	• A decrease in the rate of reported physical overload from 46 % in 2010 to 25 % in 2016 was achieved. • Continental reported an increase in the age stability rate from 25 % in 2010 to 44 % in 2016. • Ergonomic assessment has now been integrated into the procurement process for all Continental sites. • Analyses of exposure data have been integrated into human resources practice for reallocating people based on altered ability. • Enabling employees with impaired abilities to apply their skills and experience • The initiative has been well received by employees. • Increase of work satisfaction and well being • Increase of corporate loyalty • Continental has won the European Agency for Safety and Health at Work's (EU-OSHA) Best Practice Award. As part of the "Healthy workplaces for all ages" campaign, the EU umbrella organization recognized Continental for its group-wide ergonomics and demographics program. https://www.continental-corporation.com/en/press/press-releases/continental-wins-eu-award-72544) https://www.institut-aser.de/out.php?idart=857 https://osha.europa.eu/en/tools-and-publications/publications/healthy-workplaces-good-practice-awards-2016-2017-booklet/view https://healthy-workplaces.eu/previous/all-ages-

	2016/de/oshevents/healthy-workplaces-summit-2017-healthy-workplaces-all-ages-0 https://healthy-workplaces.eu/previous/all-ages-2016/sites/default/files/06_J%C3%B6rg%20Nimoth_HWC_Continental_AG_22_11_2017.pdf
Applicability limitations	Holistic approach involves effort at the beginning and requires readiness for change.

General information	Best Practice on motivational approaches
Name of the best practice	Go Sun Smart (GSS)
Short description	"The effectiveness of Go Sun Smart (GSS), an occupational skin cancer prevention program, was evaluated five-seven years out from the conclusion of a controlled randomized dissemination trial that compared an enhanced v. basic dissemination strategy at 53 ski areas enrolled in the trial." (PDF) The Sustainability of an Occupational Skin Cancer Prevention Program. Available from: https://www.researchgate.net/publication/283511782_The_Sustainability_of_an_Occupational_Skin_Cancer_Prevention_Program [accessed Apr 02 2019].
Covered area/industrial sector	Outdoor Workers / Employees at ski areas
Promoter	http://www.gosunsmart.org/ https://www.researchgate.net/publication/283511782_The_Sustainability_of_an_Occupational_Skin_Cancer_Prevention_Program
Indicative cost	This research was supported by a grant from the National Cancer Institute: CA159840. No further information
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability / public health skin cancer prevention program for outdoor workers: specific preventive behaviors
Domain/type of solution	• Domain 4 Healthy habits programs Specific preventive behaviors • applying sunscreen and protective lip balm • wearing a hat • wearing protective eyewear

Need of training to implement the motivational approach or/and the best practice	GSS delivers advice and training through a variety of workplace communication channels (e.g., posters, newsletter articles, intranets, training programs, and websites)
Results and benefits	The conclusion of following the GSS program is that exposure to prevention messages is an important determinant of program effectiveness and potentially of program sustainability.
Applicability limitations	Dedicated to outdoor workers with high UV exposure.

General information	Best Practice on motivational approaches
Name of the best practice	Which firms employ older workers?
Short description	"The paper builds on earlier literature that shows that firms employ older workers, but they tend not to hire them, and provides an explorative analysis of the establishments that employ older workers." https://www.oru.se/globalassets/oru-sv/institutioner/hh/workingpapers/workingpapers2018/wp-14-2018.pdf
Covered area/industrial sector	The analysis was performed on the basis of employer-employee data from Swedish administrative registers.
Promoter	Örebro University School of Business, 701 82 Örebro Sweden Daniela Andrén Daniela.Andren@oru.se Lackson Daniel Mudenda Lackson.Mudenda@oru.se Nicklas Pettersson Nicklas.Pettersson@oru.se
Indicative cost	No information available.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability Investigation due to the importance of allowing people as they grow older to continue to work according to their work capacity and preferences.
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers • descriptive analysis of which firms employ older workers
Need of training to implement the motivational approach or/and the best practice	Not applicable

Results and benefits	The study suggests that "the firm size is an important factor for the decision of employing older workers. The magnitude of the average marginal effect is affected by the firm's age, ownership and sector. The most significant change was driven by the control of the self-employment, being driven by the combination of many micro-firms and own by younger and middle-age self-employed. The firm ownership is an important factor for the decision of employing older workers. Private firms with no group affiliation have a higher probability to employ workers 66 or older than firms owned by state and municipalities, which might be a result of different institutional rules. Foreign ownership implies a lower probability of employing older workers. Moreover, even the legal form of firm is an important factor, sole Joint and limited partnership and non-profit organizations having a higher probability of employing older workers. […] While both researchers and politicians increasingly view active aging as a potential problem, the relatively large variation in employment of older workers across firms and establishments remains poorly understood. An array of possible explanations exists. The most straightforward are differences in rules and laws that regulate the age when the individuals can be employed, but also an expectation of different attitude among employers to avoid investing in older workers. This paper presented an explorative analysis of the characteristics of the firms employing older workers with a focus on the definition of older workers, since this varies across studies. […] Essentially, this outlaw the use of mandatory retirement at age 65, a previous common practice. Most explanations for this age rely on the notion that a worker's productivity declines significantly after age 65, and therefore it may be viewed as optimal to terminate workers at a certain age rather than to reduce their wages accordingly. Therefore, employers could use the human capital of older workers as long as these people are able and willing to work to a satisfactory productivity. […] Pleasant physical environment and strong local government are important incentives for establishment location, and should be further investigated in relation to job generation. Nonetheless, the focus should mostly be on supporting people to continue to work according to their capacities and preferences as they grow older." https://www.oru.se/globalassets/oru-sv/institutioner/hh/workingpapers/workingpapers2018/wp-14-2018.pdf (03.04.2019)
Applicability limitations	N/A

Annex II: Technologies analysed

General information	X Technology □ Application
Name of the application or technology	Smartcap technologies
Short description	Wearable technology that eliminates microsleeps by providing accurate alertness measurements in real-time to operators and drivers so they can take charge when it comes to safety, and monitor their fatigue.
Covered area/industrial sector	Drivers and operators of heavy machinery, including the ones in the transport and/or mining industry.
Manufacturer/provider	Smartcap. Head Office, Level 1, 18 Finchley Street, Milton QLD 4064 Australia
Market availability	Yes, the head-band available online in: http://www.smartcaptech.com/enquire-for-pricing/ and the Life app in Google play for free.
Indicative cost	The app for free. The headband needs to be enquired for pricing.
Licence	NA
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability. It will prevent microsleeps caused by fatigue, by predicting these with an analysis of the EEG of the user wearing a sensor under a cap or protective helmet. X Psychology/Mental abilities (including sleep problems) If the user is fatigued because he doesn't sleeps well, the sensor with the Life app will detect it. □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases (such as fatigue)

Need of training to use the solution	No need to train or calibrate. It is a pro-active solution, and has an easy to use app.
Results and benefits	This technology can prevent accidents when driving or using heavy machinery. Actually there are more than 500 installed devices with the app.
Technical limitation or applicability limitations	The headband only works with the Life app.

In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	It detects the amount of fatigue by monitoring the EEG in real time and provides alerts in case of microsleep risk, but it doesn't provide any type of API.
Interoperability with other solution	□ Yes X No

General information	X Technology □ Application
Name of the application or technology	Effectiveness of a smartphone-based worry-reduction training for stress reduction: A randomized-controlled trial
Short description	Randomised-controlled trial was conducted with individuals reporting work stress (n = 136). Participants were randomised to the experimental, control or waitlist condition (resp. EC, CC, WL). The EC and CC registered emotions five times daily for four weeks. The EC additionally received a worry-reduction training with mindfulness exercises. Primary outcome was 24-h assessments of HRV measured at pre-, mid- and post-intervention. Secondary outcomes were implicit affect and stress.
Covered area/industrial sector	This could cover any work that generates stress
Manufacturer/provider	The authors of the trial, used the VGZ mindfulness coach application (https://www.vgz.nl/mindfulness-coach-app)
Market availability	Yes, on google play and App Store
Indicative cost	Free
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) The use of mindfulness sessions were used to try to reduce work stress. □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas (according literature) (select one or more and delete the others) • Domain 3: Improving productivity and workability • New therapies Mindfulness
Need of training to use the solution	Easy to use solution that needs no training.
Results and benefits	A total of 118 participants completed the study. No change from pre- to post-intervention was observed for the primary or secondary outcomes. The change over time was not different between conditions. Findings suggest that the training was ineffective for improving HRV or psychological stress.
Technical limitation or applicability limitations	The technology used does not solve the problem of work stress.

In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	The app used doesn't gathers any variables, as it provides mindfulness training audios.
Interoperability with other solution	□ Yes X No

General information	X Technology □ Application
Name of the application or technology	PFO wearable security
Short description	PFOtech offers security technologies based on GPS Bracelets with SOS functionality and the corresponding Software / APPs. Target users are lone workers, explorers, Press, etc.
Covered area/industrial sector	It could enhance the safety feeling of workers in dangerous environments, lone workers, workers in critical areas.
Manufacturer/provider	info@pfotech.com +46 8 300 500 For information on purchasing, unit sales or system integration, please contact sales@pfotech.com
Market availability	Yes
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability It doesn´t solve any problems, but it helps all person to get help in danger or critical situations. It could be helpful as a bodyguard for kits but also for lone workers, hikers, persons with cognitive impairments, and more.
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers. Tool for communicating an emergency.
Need of training to use the solution	For the bracelet itself there is no real training needed. Just an explanation how an emergency call can be initiated. The different apps and web application might need some training at least for not IT-literate persons.
Results and benefits	Make lone workers feel more safely and observed in critical situations. Allow employers to track their employees.
Technical limitation or applicability limitations	The localization works with GNSS therefore optimal (exact) results can only be expected in the outside. Even high obstacles in the area like trees, hills, or in canyons may lead to inaccurate position information.
In case of an application:	It gathers localization and can send an alarm, but it is not retrievable.

which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	
Interoperability with other solution	□ Yes X No

General information	X Technology □Application
Name of the application or technology	Telework as an Option to Postpone the Retirement for Ageing People?
Short description	Employers provide the possibility to employees to work from home instead of commuting to office and work there. https://content.sciendo.com/view/journals/ste/8/1/article-p15.xml
Covered area/industrial sector	Workplace
Manufacturer/provider	Main author René Arvola
Market availability	N/A
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability Telework can be seen as a tool of influencing the senior employees to postpone their retirement.

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to use the solution	Depending on the IT-literacy some workers might have to learn the different tools that support telework.
Results and benefits	PROs: "*reduced stress from commuting; better work environment due to reduced noise, better concentration on work; and conditions that make easier balancing the work and family demands*" [https://doi.org/10.1515/ste-2017-0003] CONs: Knowledge transfer works better if face to face meetings are possible. Risks of social alienation
Technical limitation or applicability limitations	Only feasible if the work environment is set up fully digital thus all necessary data are available via remote.
In case of an application: which variables does it	N/A

gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	
Interoperability with other solution	X Yes □ No how? Depends on the implemented solution. This will be checked after with WP4 and WP5 partners

General information	X Technology □ Application
Name of the application or technology	Digital Human Modelling of obese and aging workers in automotive manufacturing
Short description	Through use of CATIA Delmia (Dassault Systémes) digital human modelling software tool, this research investigates how modelling software can be utilized in a number of ways to depict variations in worker size and age, for planning manual assembly and other work tasks.
Covered area/industrial sector	Automotive manufacturing industry
Manufacturer/provider	Author: Carolyn M. Sommerich, Engineering Laboratory For Human Factors/ Ergonomics/ Safety, Department of Integrated Systems Engineering, The Ohio State University College, Baker Systems Engineering , sommerich.1@osu.edu, 614-292-9965, 276 Baker Systems
Market availability	N/A
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The objective of this study was to improve the understanding of how to better create and utilize digital human models that reflects a worker population that is diverse in stature, weight, and age. □ Sensory ability X Physical ability The objective of this study was to improve the understanding of how to better create and utilize digital human models that reflects a worker population that is diverse in stature, weight, and age. □ Psychology/Mental abilities (including sleep problems) X Workability Human models allow better adaptation of the workplace.

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to use the solution	Requires knowledge of digital human modelling.
Results and benefits	This research was able to show the limitations of current applications of human modelling with respect to the age, weight, and stature of a diverse worker population and provides suggestions for how to improve modelling.
Technical limitation or	N/A

applicability limitations	
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	N/A
Interoperability with other solution	N/A

General information	X Technology □ Application
Name of the application or technology	iHeart
Short description	The technology combines a fingertip device to measure blood oxygen saturation and heart rate, an app for smartphone or tablet and personal online dashboard to determine Internal Age by measuring the stiffness of the aorta. Aortic stiffness is a proven metric for overall organ health and is capable of predicting risk of death from all causes. https://goiheart.com/assets/files/user-manual.pdf
Covered area/industrial sector	General use for personal health and wellness
Manufacturer/provider	iHeart, https://goiheart.com/contact phone number:1 866 863 2942
Market availability	Yes
Indicative cost	$149 $9.99 for 12 months subscription for Pro edition
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability: It helps to determine internal age to prevent risk of death, and physical status. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	  • New therapies Yoga, Taichi, Mindfulness
	  • Leisure programs

Need of training to use the solution	Not really, requires basic ICT skills.
Results and benefits	iHeart aims to guide people in making healthy lifestyle choices and to show objective results that lead individuals to feeling better and living longer. iHeart measures aortic stiffness, a medically-accepted predictor of risk of death from all causes. Aortic stiffness is linked to stiffness of the spinal column, internal organ function, and circulation of cerebrospinal fluid to the brain, and is known to predict risk of future heart disease and

	dementia in individuals as young as 30.
Technical limitation or applicability limitations	Available for both IOS and Android (5.0+) phones and tablets. Not available for iPods or PCs.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	• Blood oxygen saturation • Heart rate • Aortic pulse wave velocity These variables are measured by the fingertip device
Interoperability with other solution	X Yes □ No how? A report can be send by email. This will be checked after with WP4 and WP5 partners

General information	X Technology □ Application
Name of the application or technology	Using sensor technology for workplace health promotion: A needs assessment among manual workers: Sander Spook
Short description	Sensor technology in the workplace to monitor work and health parameters and provide real time feedback to the user. Four on-site focus group sessions were conducted within four different companies among manual workers (n = 30). Semi-structured interview schedules were used and included questions about which work and health parameters workers would you like to be measured with sensor technology and how workers would like to receive feedback on the work and health parameters. They would like to receive real-time feedback from sensor technology applications to prevent exceeding exposure limits for heat, noise or lifting.
Covered area/industrial sector	All industrial sectors that involve manual labor.
Manufacturer/provider	Paper published in European Journal of Public Health, Volume 27, Issue suppl_3, November 2017, https://academic.oup.com/eurpub/article/27/suppl_3/ckx186.350/4555962 Main author: Sander Spook, University Medical Center Groningen, NL
Market availability	No, it is a scientific paper
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability Workers experienced physical strain, fatigue, heat and noise, which they want to measure during work time. They would like to receive real-time feedback from sensor technology applications to prevent exceeding exposure limits for heat, noise or lifting. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 1: Policy for older workers • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
Need of training to use the solution	Not necessary.
Results and benefits	Real-time feedback on work and health aspects, such as physical strain, fatigue, heat and noise, provided by sensor technology applications may be used to prevent unhealthy work activities and adverse health outcomes. Hazardous work situations can be avoided and health behaviour may be improved. Individual reports may help to open a dialogue with the relevant work and health stakeholders about improving workplace health.
Technical limitation or applicability limitations	The technical limitations will depend on the type of sensor technology applications used in each case.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	N/A
Interoperability with other solution	□ Yes X No

General information	X Technology □ Application
Name of the application or technology	Effects of Cyber-Physical Production Systems on Human Factors in a Weaving Mill
Short description	The analysis concerns the acquisition of new skills that is expected from workers, due to the merging of physical and virtual environments via Cyber-Physical Production Systems, with particular emphasis on Augmented Reality (AR) assistance in Industry 4.0 environments. The analysis refers to German textile industry. The mentioned skills vary individually, resulting from diverse cultural, educational, age- or gender-related socio-demographic backgrounds of workers. In particular, the following need to be considered: • Increasing complexity due to both operational functions and increasing workforce diversity in Germany • Changes in processes, work structures and tasks of weaving mill employees, at all qualification levels (e.g. decrease in monotonous tasks; machine controlling "by foot" eliminated; IT skills needed to operate tablets, data glasses, etc.) • Aging of the workforce To address these aspects, UX engineering is to be applied (part 210, "Human-centered design of interactive systems", of the ISO 9241 series "Ergonomics of human system interaction"). The analysis presents a use case based on the application of an AR-based handling support for weaving machine operators. In particular, it assists operators in handling problems regarding weft yarn breakages. The prototype uses Epson Moverio BT-200 smart glasses by Seiko Epson Corp., Nagano, Japan, and the Android software development kit (SDK) by Metaio GmbH, Munich, Germany. The part of the machine to be operated on has to be focused with the camera of the smart glasses. The application detects the position where the weft yarn is broken and provides the operator with individual case-specific AR-based assistance. Other devices, such as smartphones or tablets, can be used instead of the smart glasses.
Covered area/industrial sector	Textile industry (but easily extendable to other industries)
Manufacturer/provider	The technology is a research result from the RWTH Aachen University Aachen, Germany
Market availability	No, because the AR product is a research prototype
Indicative cost	The authors do not provide information on the costs for implementation and deployment. However, costs of HW can be low (as smartphones can also be used, if the cost for smart glasses cannot be afforded). Uncertainty regards the costs of the software developed by the authors,

	which is not commercially available. In particular, costs for customizing the solution for every different type of machine are expected to be significant (a likely business model would be that the content is directly produced by the supplier of the machine. But this would require strong, probably de-facto, standardization of the solution)
Licence	The AR product is a research prototype, for which no commercial licence is currently available
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions • The system directly tackles learning new skills, as it provides "just-in-time" information, even for workers with low level of experience (e.g. an older worker dealing with a new type of machine, that is significantly different from the ones she/he has grown expert with) • The system is cost-effectively customizable for a diverse workforce. E.g. language can be adapted to address workers with immigrant background. X Sensory ability • The system is can cost-effectively accommodate declining visual abilities in older workers, e.g. by using larger fonts or pictograms instead of text □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability • The application detects the position where the weft yarn is broken and provides the operator with individual case-specific assistance according the needs of the worker.

Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline

Need of training to use the solution	No training is needed, apart from basic instruction on the AR app usage.
Results and benefits	Consistently with the above, expected benefits are: • Assistance when new skills are needed (it is also easy to think extending the prototype to go beyond assistance towards full-fledged training support) • Adaptability to declining visual abilities
Technical limitation or applicability limitations	Applicability may depend on the complexity of the tasks to be supported, that in some cases may not be amenable to a "point-the-camera-and-see" approach, typical of AR application to repair support.
In case of an application: which variables does it	In the description of the authors, the only data acquired are the images from the smart-glasses' camera, needed to query the support repository

gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	and to provide augmented information.
Interoperability with other solution	□ Yes X No The system is a research prototype

General information	X Technology □ Application
Name of the application or technology	Kenzen Patch – Monitor parameters directly associated with heat stress
Short description	Kenzen Patch is a small device, to be worn during the work shift by workers and technicians, to get real-time health and safety information. It combines sensors and predictive models to obtain real time feedback on user's performance, motion and vitals. The core models are based on sweat biomarkers, such as sodium, glucose and proteins. Kenzen's technology allows molecules like these to be collected and measured non-invasively using proprietary sensors. The Kenzen Monitor can be worn in two locations: the torso (over the heart), or the upper arm. The user should peel a disposable patch and use it to adhere the monitor to the body. Data are then transmitted to a smartphone app, that provides: • Real-time reporting of Heart Rate, Sweat Rate, Body Temperature and Activity • View personal trends and historic reports • Real-time alerts with OSHA-based follow-up recommendations • Add flags to capture important health events In addition, dashboards are available for OH and HR management, in order to supervise teams and personnel, analyse relevant risks, produce safety reports. Data is aggregated and anonymized and no individual health information is exposed, in order to protect workers' privacy.
Covered area/industrial sector	The technology is being field-tested in the sectors of construction, renewable energy, power, mining, manufacturing and oil & gas.
Manufacturer/provider	Kenzen, Inc. (San Francisco, CA, US; Zuerich, CH; Zizers, CH)
Market availability	Yes, currently available in limited release. The product is sold to businesses (although bringing it to retail market is planned).
Indicative cost	Around $300. However, Kenzen Sales should be contacted for specific quote.
Licence	NA
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability • Prediction of physical health issues, such as dehydration or cramping □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	• Domain 4 Healthy habits programs
	  • Physical activity
	  • Vacuums and medical check (early prevention programs)

Need of training to use the solution	No training is needed, apart from understanding the apps UI.
Results and benefits	Real time prediction of critical risks for the safety of workers
Technical limitation or applicability limitations	Applicability is limited to conditions that can be detected on the basis of sweat biomarkers, combined with other sensors such as HR, temperature and accelerometer sensors.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Heart Rate, Sweat biomarkers, Body Temperature and Activity, collected through proprietary sensors.
Interoperability with other solution	□ Yes X No The system is proprietary

General information	X Technology □ Application
Name of the application or technology	Empatica E4 wristband
Short description	The E4 wristband is a wearable research device that offers real-time physiological data acquisition and software for in-depth analysis and visualization on the computer and real-time visualization on the application for smartphones. It has got four sensors: • PPG Sensor - Measures Blood Volume Pulse (BVP), from which heart rate and heart rate variability can be derived • EDA Sensor (GSR Sensor) - Measures the constantly fluctuating changes in certain electrical properties of the skin • 3-axis Accelerometer - Captures motion-based activity • Infrared Thermopile - Reads peripheral skin temperature
Covered area/industrial sector	All groups of employees, but it is designed for research purposes
Manufacturer/provider	Empatica Inc., 1 Broadway, Cambridge, MA 02142, United States - Empatica Srl, Via Stendhal 36, 20144 Milano (MI), Italy P. IVA IT07462810966 - Copyright © 2018 Empatica Inc. sales@empatica.com
Market availability	Yes https://www.empatica.com/research/e4/
Indicative cost	$1,690.00/piece, depending on the quantity ordered
Licence	NA
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – it measures HR, HRV and skin temperature which are physical ability indicators X Psychology/Mental abilities – it measures galvanic skin response which is an indicator of stress/strain X Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools

Need of training to use	Yes

the solution	
Results and benefits	Not described on the webpage, but CIOP-PIB has used this device in another Horizon 2020 project: *INCLUSIVE – Smart and adaptive interfaces for INCLUSIVE work environment*, and our results has shown that this device is very vulnerable to artefacts and the signal is quite noisy and real-time algorithms for data filtering should be applied. We tried to use Matlab programming but it wasn't advanced enough and our project partners managed to filter the signal using ThingWorx Analytics for Real-time Scoring and medical algorithms.
Technical limitation or applicability limitations	Device very vulnerable to artefacts and the signal is very loud, especially in the move.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Blood Volume Pulse (BVP), galvanic skin response, motion-based activity, peripheral skin temperature. Retrievable via API
Interoperability with other solution	X Yes □ No Through the API

General information	X Technology □ Application
Name of the application or technology	AR: Mobile augmented communication for remote collaboration in a physical work context Pejoska-Laajola, J., Reponen, S., Virnes, M., & Leinonen, T. (2017). Mobile augmented communication for remote collaboration in a physical work context. *Australasian Journal of Educational Technology, 33*(6), 11-26. https://doi.org/10.14742/ajet.3622
Short description	The aim was to explore whether mobile video conversations augmented with on-screen drawing features were beneficial for improving communication and remote collaboration practices in the construction and facility maintenance services sectors. The authors used field studies in real work contexts to map how participants solve physical tasks with remote help powered by augmented video calls, and examined how the drawing feature was used in these contexts. Social augmented reality app SoAR was developed. It is a mobile app that enhances video calls for the purposes of asking questions and providing guidance in context-dependent work situations. SoAR offers features for live visual assessment, remote augmented communication and enhanced collaboration with pointing and drawing. SoAR is an open source, Android-based mobile app that is entirely free to use. Once an individual registers as a user, the app enables access to video calls for any contacts from the user's phone contact list. The video stream shares what each participant sees (i.e., the back camera view) rather than a face view of the participant (i.e., the front camera view). The audio can be muted from both side if necessary, and each participant in a call can choose to view the current view or to switch the shared view to the back camera view at any point. The stream can be also paused, enabling a static view frame. The participants can draw on top of the live stream or the static frame with their finger or use predetermined shapes (e.g., pointers, circles etc.) as a means of communication.
Covered area/industrial sector	Construction and facility maintenance sector
Manufacturer/provider	Jana Pejoska-Laajola, jana.pejoska@aalto.fi
Market availability	Yes (but I couldn't find it online, need to contact the authors if relevant)
Indicative cost	Free
Licence	If available

Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions – SoAR was designed to provide mobile video conversations augmented with on-screen drawing features that are beneficial for improving communication and remote collaboration practices. It facilitates communication and learning, e.g. in the context of safety issues at work site. □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 1: Policy for older workers
	  • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies

Need of training to use the solution	Yes
Results and benefits	The field study outcomes suggest that the SoAR app is a potential solution, especially for acute and ad hoc work situations. In sum, SoAR could improve communication in quality and supply chain management work processes in the construction and facility maintenance sectors.
Technical limitation or applicability limitations	As authors stated, SoAR is an open source, Android-based mobile app that is entirely free to use. However, I couldn't find it online so I'm not sure about this.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	None
Interoperability with other solution	□ Yes □ No (It depends on the implementation)

General information	X Technology □ Application
Name of the application or technology	Use of wearable and augmented reality technologies in industrial maintenance work: 1. Wearable System for Data Collection and Reporting 2. Augmented Reality System for Task Guidance
Short description	Authors have studied knowledge-sharing solutions using Augmented Reality (AR) and wearable technologies in actual industry cases to find out if maintenance technicians find them useful and usable in their everyday work. Two test cases were included: the use of a wearable system consisting of three devices in the crane industry, and the use of AR guidance in the marine industry. The wearable system was developed to improve communication between the information systems and a maintenance technician. The system was proposed to facilitate on-site reporting system and to shorten the reporting time afterwards. A feasibility demo application for the wearable system was implemented using Android smartphone (Samsung Galaxy S5), a Sony Smartwatch 3, and M100 Smart Glasses / head-up display (VUZIX). Kontakt-io Bluetooth beacons were tested for optimal location on the factory premises. With the demo application setup, technicians were able to document and report service results. Augmented Reality System for Task Guidance was designed in order to give more comprehensive and interactive guidance for the maintenance technician. The system was built on an iPad Air tablet using Metaio Creator. The user interface was Junaio. The maintenance technician receives help that is available in information systems via a tablet and an AR application. The maintenance technician was given a list of maintenance steps and visual guidance on what to do in the subsequent steps. Visual guidance could be given via 2D drawings, 3D models, or symbols. The 3D models and symbols were animated to show the correct operating direction. The system allowed the maintenance technicians to proceed at their own pace and acknowledge when a maintenance step is completed. At each step, the system informs about the required tools, spare parts, and the technical information needed to execute the maintenance work successfully. The system ensures that all necessary maintenance procedures are performed, and enables the information to be updated in the customer's system.
Covered area/industrial sector	Maintenance / crane industry / marine industry
Manufacturer/provider	Susanna Aromaa VTT Technical Research Centre of Finland Ltd P.O. Box 1000, 02044 VTT, Finland + 358 40 724 9828 susanna.aromaa@vtt.fi

Market availability	No information
Indicative cost	No information
Licence	Not available
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions; as a knowledge-sharing solution enables the easy learning through AR □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability; the use of AR in maintenance tasks could facilitate the work

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 1: Policy for older workers
	  • Tools and technologies aimed at improving interpersonal communication between the latter and other workplace workers.
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies – tested solutions aimed to make on-site reporting easier and to shorten the reporting time as well as to give more comprehensive and interactive guidance to the maintenance technician. By these means, these solutions could protect early retirement.
	• Domain 3: Improving productivity and workability – tested solutions were assessed as making work easier so they could impact workability and productivity of older workers.

Need of training to use the solution	Yes

Results and benefits	In both cases, two maintenance technicians (aged 23 and 54) tested the technologies and data were collected using questionnaires, interviews and observation. The maintenance technicians thought that the adaptation of the wearable system could have a positive impact on their work and could facilitate their work. The evaluated system, however, slowed down their work because the technicians needed to change between devices during the maintenance task. It was easy to learn to use the complete wearable system. Sometimes, however, it was difficult to remember whether to use the smartwatch or the smartphone. Therefore, the maintenance technicians would prefer to use only one of them. Due to the number of devices, the use of the system was a little bit too complicated and interfered with working. The system decreased hands-free working and it could be a safety issue in this environment. As for the augmented reality system for task guidance, the use of the AR system could be beneficial and have a positive effect on maintenance work. The system could be useful especially when certain maintenance tasks are done for the first time. Despite the system intruding on their traditional working process, the participants felt that they were able to focus on their work. By means of this system, it would be possible to decrease the amount of work that needs to be done before an actual maintenance task. The use of the system could also change the work in a way as to reduce the number of telephones and interpersonal communication. It could also decrease the amount of errors/mistakes. On the other hand, it disturbed their work flow, since they were not used to using that kind of system in their everyday work. Aims of these solutions were not fully achieved so they cannot be implemented in the form described in the paper.
Technical limitation or applicability limitations	Some practical issues were raised concerning the simultaneous use of multiple devices and the placement of the devices. The system was proposed for the maintenance work.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	NA.
Interoperability with other solution	X Yes □ No Depends on the implementation

General information	X Technology □ Application
Name of the application or technology	JumpStart
Short description	Intelligent, personalized, ergonomic footbeds as shoe inserts with transferable sensors and electronics that collect health, wellness and fitness data in combination with the corresponding app Holmz.
Covered area/industrial sector	- Individuals: Manage musculoskeletal health and optimize performance - Clinicians: Perform biomechanical assessments incorporating patient daily activities - Sport athletes: optimize performance and mitigate risk of injuries - Coaches/Trainer: manage development of athletes
Manufacturer/provider	"JumpStart^{CSR}, a Seattle-based Delaware C corporation formed in 2015, is a hardware enabled SaaS focused on helping people regain, improve, and optimize their musculoskeletal heath and performance." http://www.jumpstartcsr.com/about-us.html (03.04.2019) contact possibility via the website's contact form: http://www.jumpstartcsr.com/get-involved.html
Market availability	In beta stage (startup)
Indicative cost	No information available
Licence	No information available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability The product uses intelligent digital materialization in the form of personalized intelligent footbeds that are worn in shoes. The insoles equipped with sensors record data about musculoskeletal health and performance which can be retrieved via an application. □ Psychology/Mental abilities (including sleep problems) □ Workability

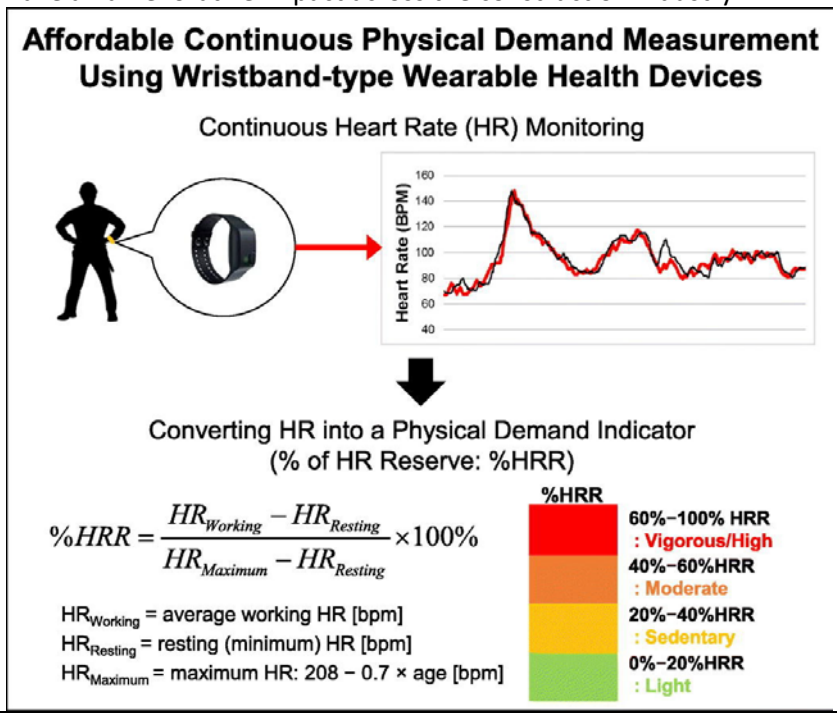
Domain/type of solution	Identified domain that cover the needs of different industry areas (according literature) (select one or more and delete the others)
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	  • Optimize physical performance
	  • Mitigate risk of injury
	• Domain 4 Healthy habits programs
	  • Physical activity
	  • Monitor biomechanical health

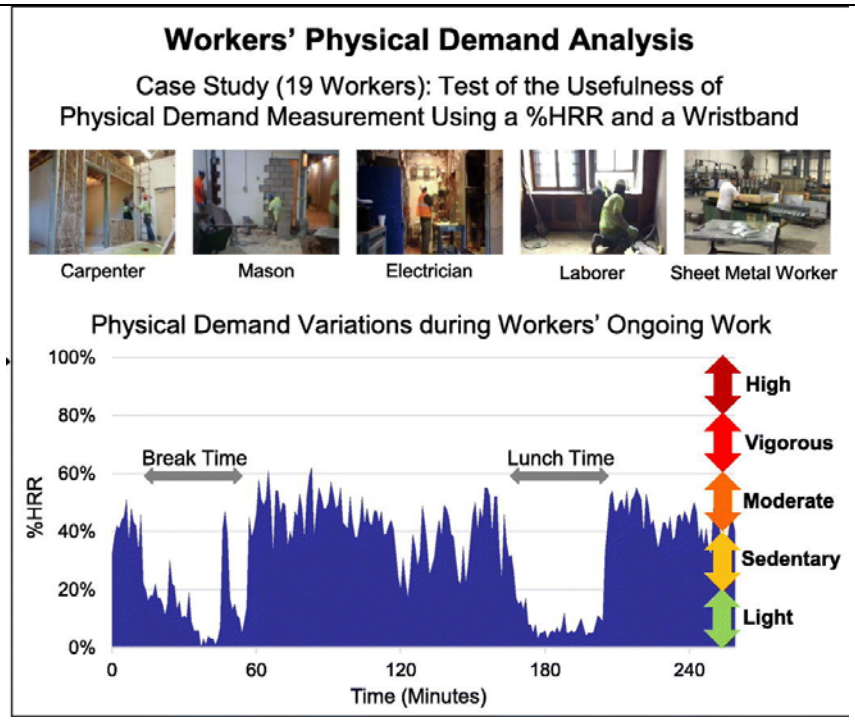
Need of training to use the solution	No information available. But as it is a personalized wearable which replaces the old footbeds of the shoes, probably there is no need of training to use the solution.
Results and benefits	As the company is a startup there are no real information about the results and benefits of the technology. But it should help people regain, improve, and optimize their musculoskeletal heath and performance.
Technical limitation or applicability limitations	The company is still in an early stage (startup) so that the product is probably only available as a beta version.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Sensor data of physical activity via personalized, intelligent footbeds. Data to set up user profiles in the app and population data to personalize the parametric model.
Interoperability with other solution	□ Yes X No

General information	X Technology □ Application
Name of the application or technology	Wearable wristbands
Short description	Wristband-type wearable health devices equipped with biosensor systems (e.g. heart rate sensor) that measure the physical demands of construction workers
Covered area/industrial sector	Construction industry, workers with high physical demands
Manufacturer/provider	Not specified, case study with different wearables Authors: Sungjoo Hwang (Department of Architectural and Urban Systems Engineering, Ewha Womans University, Republic of Korea) and SangHyun Lee (Tishman Construction Management Program, Department of Civil and Environmental Engineering, University of Michigan, United States)
Market availability	Yes, but not specified
Indicative cost	No information available.
Licence	No information available.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability Measurement of physical demands, especially heart rate (HR) by wearing a wristband. %HRR-based physical demand measurement. Continuously calculation without interfering of the work processes. Protection of the workers' safety and health and support of the expected productivity. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Anticipating potential health and safety problems from excessive physical demands
	  • Anticipating productivity loss before it occurs
	• Domain 3: Improving productivity and workability
	  • Protect worker's safety and health by continuous measurements of physical demands
	  • Support productivity of the workers

Need of training to use the solution	No need of training to use the solution because it is a wristband which can be worn during work without interfering the working processes.
Results and benefits	"The results show that workers' physical demands are highly variable according to their working patterns (i.e., direct work, and indirect work including tool/equipment/material handling, traveling, and preparatory work), combined influences of work tasks, as well as individual and environmental factors (e.g., age and heat stress). These results

	demonstrate the need for continuous physical measurement during workers' ongoing work so that any significant high physical demands, which need to be avoided if possible, can be captured. The findings of this paper show that the continuous measurement of physical demands using a wristband provides rich information to understand, manage, and design physically demanding construction work (e.g., flexible work-rest cycle and managing demanding indirect work) by balancing workloads throughout a day and/or reducing unnecessary physical demands beyond direct work. By anticipating potential health and safety problems from excessive physical demands, as well as productivity loss before they occur, this research will have an ameliorative impact across the construction industry." 

	 https://www.sciencedirect.com/science/article/pii/S0926580517305010 (03.04.2019)
Technical limitation or applicability limitations	Not specified as it is not clear which wristbands were used.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Wristband-type wearable health devices have sensors that measure the physical demands as a percentage of HR reserve (%HRR) which is useful by normalizing individual differences of the heart rate (HR).
Interoperability with other solution	X Yes □ No how? Through an API available in some wristbands. This will be checked after with WP4 and WP5 partners

General information	X Technology □ Application
Name of the application or technology	Nintendo Wii Comparable technologies: PlayStation Move (Sony) Xbox & PC Kinect (Microsoft)
Short description	"Fitness game, exergaming or exer-gaming (a portmanteau of "exercise" and "gaming"), or gamercising is a term used for video games that are also a form of exercise. Exergaming relies on technology that tracks body movement or reaction. The genre has been credited with upending the stereotype of gaming as a sedentary activity, and promoting an active lifestyle. Exergames are seen as evolving from technology changes aimed at making video games more fun." https://en.wikipedia.org/wiki/Exergaming
Covered area/industrial sector	• improving physical function • decreasing depression • increasing cognition and quality of life • improved socialization and motivation in older adults
Manufacturer/provider	Nintendo Co., Ltd. https://www.nintendo.com/ Sony Corporation https://www.sony.net/ Microsoft Corporation https://www.microsoft.com/
Market availability	Yes in (online) retail, e.g. https://www.amazon.com/
Indicative cost	Nintendo Wii approx. 310€ PlayStation Move (Sony) PlayStation 4 & Move Controller approx. 350 € Xbox Kinect (Microsoft) approx. 300 € PC Kinect (Microsoft) approx. 180 €
Licence	No information

Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability • improving physical function X Psychology/Mental abilities (including sleep problems) • decreasing depression • increasing cognition and quality of life • improved socialization and motivation □ Workability

Domain/ type of solution	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4 Healthy habits programs
	  • Physical activity

Need of training to use the solution	Learning by doing
Results and benefits	"A total of 22 empirical studies met inclusion criteria and were included in this review. Positive effects included improving physical function, decreasing depression, and increasing cognition and quality of life in older adults. Improved socialization and motivation to exercise were also reported." (Chao et al. 2015). Tables from Chao et al. 2015 (https://journals.sagepub.com/doi/abs/10.1177/0898264314551171) other reviews an studies available, e.g. https://www.researchgate.net/publication/255964181_Bedeutung_von_Exergames_in_der_Bewegungsforderung_alterer_chronisch_kranker_Menschen
Technical limitation or applicability limitations	Hardware and software (games) required. Interfaces to other platforms partly available / usable.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	- tracking body movement or reaction - highscores etc. (in games) Open source software and API available. e.g. http://flafla2.github.io/2015/10/16/wiimoteapi.html
Interoperability with other solution	X Yes □ No how? Through Open source software and API available. e.g. http://flafla2.github.io/2015/10/16/wiimoteapi.html This will be checked after with WP4 and WP5 partners

General information	X Technology □ Application
Name of the application or technology	Samsung Smart Phone S10+ for monitoring parameters directly associated with Samsung Health app.

Short description	Samsung Smart Phone S10+ is a device, to be used during the work shift and at home by workers, to get real-time health through Samsung Health. It combines sensors and models to obtain real time feedback on user's performance, motion and vitals.
	
	The phone spec is based on the following low level characteristics:
	
	• MODEL NUMBER
	  o SM-G975U1
	• OPERATING SYSTEM
	  o Android™ 9.0 Pie
	• DISPLAY
	  o 6.4" QuadHD+(3040x1440)
	  o Dynamic AMOLED
	• MEMORY
	  o 8 GB RAM
	  o 128 GB ROM
	  o Expandable up to 512 GB with MicroSD slot (card sold separately)
	• WATER RESISTANCE
	  o IP68 Certified
	  o Water resistant in up to 1-meter water for up to 30 minutes
	• PORTS
	  o USB Type-C
	  o 3.5 mm headset Jack
	• SIM CARD
	  o Nano SIM
	• PROCESSOR
	  o Qualcomm® Snapdragon™ 855
	  o Processor Speed: 2.8 GHz + 2.4 GHz + 1.7 GHz
	  o Graphics processor: Adreno 640 GPU
	• CONNECTIVITY
	  o WiFi: 802.11 a/b/g/n/ac/ax (2.4 GHz + 5 GHz)
	  o Cellular: GSM (850, 900, 1800, 1900 MHz);
	  o CDMA (800, 1900 MHz)
	  o UMTS (B1, 2, 4, 5, 8)
	  o 4G LTE (B1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 18, 19, 20, 25, 26, 28, 29, 30, 38, 39, 40, 41 66, 71)
	  o Bluetooth: 5.0
	• BATTERY
	  o All-day battery1 (4100 mAh)
	  o Fast wired or wireless charging (wireless chargers sold separately)

	• AUDIO o 1 Front-of-device speakers o 2 mics • CAMERA o **Rear**: o 16MP Ultra wide + 12MP Telephoto + 12MP Wide-angle rear cameras with dual aperture (ƒ/1.5 + ƒ/2.4), flash, o Optical image stabilization (OIS) o **Front**: o Dual Pixel 10MP Selfie + 8MP RGB Depth cameras with dual aperture (ƒ/1.9 +ƒ/2.2), flash, AutoFocus, Live Focus • ACCESSIBILITY o Hearing Aid Compatibility (HAC) rating M4/T3 o TTY compatible o Languages supported: Android P allows you to select from 100 new languages and 25 locales for commonly used languages such as English, Spanish, French, and Arabic. • SENSORS o Accelerometer o Barometer o In-screen Fingerprint sensor o Gyro sensor o Geomagnetic sensor o Hall sensor o Proximity sensor o RGB light sensor The core Samsung Health models are based on embedded sensors, such as Accelerometer, Barometer, Gyro Sensor, HR Sensor and Light Sensor. Samsung Phone's technology allows these measurements to be collected in a non-invasively way. Data are then gathered through different approaches: 1) SDK or the Health Data's Programming Guide 2) https://developer.samsung.com/health/android/sample/sample-service.html 3) https://developer.samsung.com/health/android/sample/simple-health.html In addition, Samsung Health Phone app's dashboards are available.
Covered area/industrial sector	Samsung Smart Phone S10+ is agnostic with respect to the industry sector: it can be applied in any case where well-being, fitness management is important for workers.
Manufacturer/provider	Samsung Electronics Co., Ltd., Samsung Digital City, Samsung no 129, Maetan-dong, Yeongtong District, Suwon, South Korea
Market availability	Yes, currently available on the market.

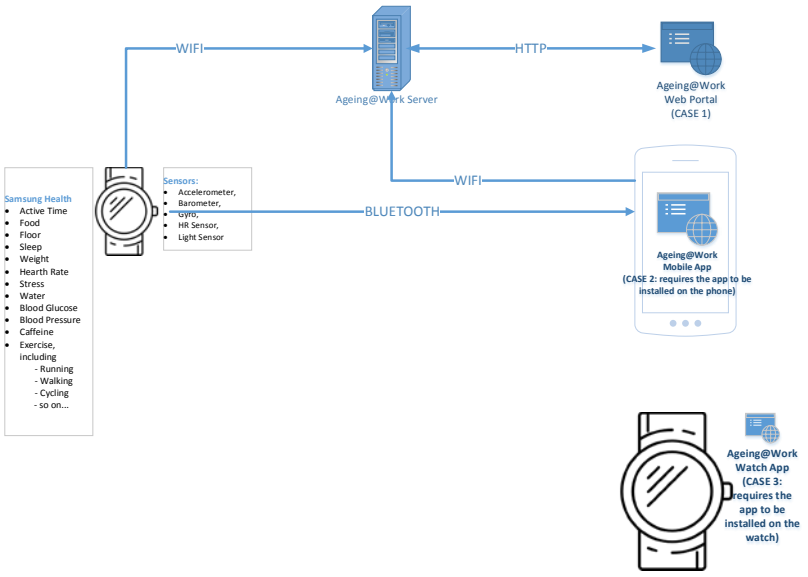
Indicative cost	Around 475.34 GBP. However, SRUK should be contacted for specific quote at the time of deploying.
Licence	NA
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions X Sensory ability • Accelerometer • Barometer • In-screen Fingerprint sensor • Gyro sensor • Geomagnetic sensor • Hall sensor • Proximity sensor • RGB light sensor X Physical ability • Physical activity tracking • Physiological parameters tracking, depending on devices' available sensors (e.g. HR monitoring) X Psychology/Mental abilities (including sleep problems) • Sleep tracking is possible. □ Workability

Domain/type of solution	• Domain 4 Healthy habits programs
	  • Physical activity
	  • Early detection & Prevention programs

Need of training to use the solution	No training is needed, apart from understanding the apps UI.
Results and benefits	Benefits are mainly in terms of adoption and maintenance of healthy habits, particularly in terms of physical activity.
Technical limitation or applicability limitations	Samsung Smart Phones is not endorsed as a medical device.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Above reported all the variables and the main modalities to collect the data.
Interoperability with other solution	X Yes □ No Interoperability is possible with other Android devices and Tizen.

General information	X Technology □ Application
Name of the application or technology	Samsung Smart Watch Galaxy Watch Active for monitoring parameters directly associated with Samsung Health app.
Short description	Samsung Watch Galaxy Watch Active is a wearable device, to be used during the work shift and at home by workers, to get real-time health through Samsung Health. It combines sensors and models to obtain real time feedback on user's performance, motion and vitals. The watch spec is based on the following low level characteristics: • Network/Bearer o InfraBluetooth Only • Connectivity o ANT+No o Location Technology GPS, Glonass, Beidou, Galileo o Wi-Fi802.11 b/g/n 2.4GHz o NFC Yes o Bluetooth Version Bluetooth v4.2 o Bluetooth Profiles A2DP, AVRCP, HID o Tizen • Display o Technology (Main Display) Super AMOLED o Size (Main Display) 1.1" (28.1mm) o Resolution (Main Display) 360 x 360 o Color Depth (Main Display) 16M • Processor o CPU Speed 1.15GHz o CPU TypeDual-Core • Memory o RAM Size (GB) 0.75 o ROM Size (GB) 4 o Available Memory (GB)*1.5 o External Memory Support N/A o • Sensors o Accelerometer, Barometer, Gyro Sensor, HR Sensor, Light Sensor • Physical specification o Dimension (HxWxD)39.5 x 39.5 x 10.5mm o Weight (g)25 • Battery o Standard Battery Capacity230mAh o RemovableNo

	o Typical Usage Time (Hours) Over 45 Hours o Low Usage Time (Hours) Up to 90 Hours o Local Storage Music Playback TimeUp to 8 Hours o Indoor Workout TimeUp to 45 Hours o Outdoor Workout Time with GPSUp to 15 Hours • Audio and Video o Audio Playing FormatMP3,M4A,3GA,AAC,OGG,OGA,WAV,WMA,AMR, AWB • Services and Applications o Notification Type Vibrate Galaxy Watch Active tracks and automatically stores • every walk, run and cycle, recognizing when you're working out; • Count every step and track your personal best; • You can even set daily goals for extra motivation; • Manage your stress levels safely; • Integrated Heart Rate Monitor; • To use Samsung Health app with Galaxy Watch Active, requires signup and pairing with your compatible smartphone; • Intended for general wellness and fitness purposes only; • Actual battery life varies by network environment, features and apps used, frequency of calls and messages, number of times charged, and many other factors. • Availability of Stress and Meditation feature may vary by country. • Some breathing techniques to bring you back in balance. • Motivation in 4 ways with the apps: MyFitnessPal, MapMyRun, Endomondo, UA Record • For more, visit https://www.samsung.com/global/galaxy/galaxy-watch-active/#ft-caption The core models are based on embedded sensors, such as Accelerometer, Barometer, Gyro Sensor, HR Sensor and Light Sensor. Galaxy Watch Active's technology allows these measurements to be collected in a non-invasively way. Data are then gathered through different approaches: 4) Via WIFI, send to a server, e.g. Ageing@Work Server; 5) Via BLEUTOOH, sent to a smart phone (as gateway), the latter sends the data to a server, e.g. Ageing@Work Server; 6) Via Tizen that provides functions for managing sensors and receiving sensor data https://developer.tizen.org/ko/development/guides/native-

	application/location-and-sensors/device-sensors?langredirect=1  In addition, Samsung Health watch app's dashboards are available.
Covered area/industrial sector	Samsung Watch is agnostic with respect to the industry sector: it can be applied in any case where well-being, fitness management is important for workers.
Manufacturer/provider	Samsung Electronics Co., Ltd., Samsung Digital City, Samsung no 129, Maetan-dong, Yeongtong District, Suwon, South Korea
Market availability	Yes, currently available on the market.
Indicative cost	Around 89.13 GBP. However, SRUK should be contacted for specific quote at the time of deploying.
Licence	NA
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability • Physical activity tracking • Physiological parameters tracking, including HR monitoring, Stress measurement) X Psychology/Mental abilities (including sleep problems) • Sleep tracking is possible. □ Workability
Domain/type of solution	• Domain 4 Healthy habits programs • Physical activity • Early detection & Prevention programs

Need of training to use the solution	No training is needed, apart from understanding the apps UI.
Results and benefits	Benefits are mainly in terms of adoption and maintenance of healthy habits, particularly in terms of physical activity.
Technical limitation or applicability limitations	Samsung Smart Watch is not endorsed as a medical device.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Above reported all the variables and the main modalities to collect the data.
Interoperability with other solution	X Yes □ No Interoperability is possible with other Tizen/Android devices.

Annex III: Apps and tools analysed

General information	□ Technology X Application
Name of the application or technology	YAZIO Calorie Counter, Nutrition Diary & Diet Plan
Short description	It's a free app for calorie counter. It allows to manage the daily food diary, track activities and give support to lose weight. It syncs with Google fit. The Pro version has nutrition plans and a coach to remind eating and drinking.
Covered area/industrial sector	Its target is the whole population, not a specific industry.
Manufacturer/provider	YAZIO GmbH, Kartäuserstr. 13a, 99084 Erfurt, Germany
Market availability	Yes, in Google Play
Indicative cost	In-app Products: €5.99 - €48.99 per item
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability As it addresses weight loss, it is linked also with the tracking of the physical activities. It has a coach in the Pro version that reminds you to eat and drink water. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	No, according to the users' comments the app is easy to use and requires no training.
Results and benefits	It provides healthy nutrition habits, and tracks the essential information related with losing weight, like exercise, calories, etc. It can benefit a large population, it has been installed in more than 5.000.000 devices.
Technical limitation or applicability limitations	It's a proprietary app and even though it syncs with google fit, this limits the applicability, also because the data has to be entered by the end users, not by wearables.
In case of an application: which variables does it	It gathers: weight, calories, steps, measures breast, waist and hip circumference. Doesn't have an API but it syncs with Google Fit.

gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	
Interoperability with other solution	X Yes □ No how? With Google Fit. This will be checked after with WP4 and WP5 partners

General information	□ Technology X Application
Name of the application or technology	Drink water reminder
Short description	It is an Android APP that reminds you to drink water. It allows to set a target amount of water and the size of the glass. It reminds you to drink regularly. Based on the size of the glass, the APP also calculates the amount of water that was drunk the day.
Covered area/industrial sector	Health and Fitness
Manufacturer/provider	Simple Health Lab developer3@smoothapps.me Flat/Rm 603, 6/F Laws Commercial Plaza 788,Cheung Sha Wan Road, KL
Market availability	Yes, Google Playstore
Indicative cost	0€ for the APP but offers In-App Purchases with 2,09 € per Article
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The APP helps to remind you to drink enough water. □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 4 Healthy habits programs • Nutrition
Need of training to use the solution	Probably depends on the IT literacy and whether you can use a smartphone. Furthermore explain users that the amount of water and time is only a recommendation and should, if need be, adapted.
Results and benefits	Remind the worker/user to maintain hydrated.
Technical limitation or applicability limitations	Need to set up the size of the cups and glasses and you need to choose the cups/glasses that you use when drinking otherwise it uses always the same size.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Statistic about the amount of water drunken per day / per month.
Interoperability with other solution	□ Yes X No
General information	□ Technology X Application

Name of the application or technology	Affrytrac Mobile
Short description	It is a web-based tool for the management of environmental health and safety compliance requirements in a working environment. Its main features include: task management, corrective actions documentation and tracking, potent compounds repository, safety self-assessment tool
Covered area/industrial sector	Life science industry (biotechnology, pharmaceutical and medical device companies)
Manufacturer/provider	Affygility Solutions, 390 Interlocken Crescent Suite 350 Broomfield, CO 80021, t: 3038843028, https://affygility.com
Market availability	Yes
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The application helps to track and manage the environmental health and safety information of a working environment. □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies
Need of training to use the solution	Probably yes, depending on ICT familiarity.
Results and benefits	The use of the application contributes to spending less time to in the office managing health and safety and environmental requirements. It facilitates environmental, health and safety compliance monitoring across multiple locations, time zones and languages.
Technical limitation or applicability limitations	Web-based tool, no software to install, internet connection needed.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	It does not gather any variables
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Dangerous goods manual
Short description	The application helps in identifying hazardous material (HazMat). Its main features include: search hazardous materials (by UN number), ERI-Cards ("Emergency Response Intervention Cards") to guide on initial actions for fire crews, - Information about hazard identification numbers (Kemler number), Hazchem Emergency Action Codes (EAC), Packaging groups, Transport category and Tunnel codes, classification and labelling summary (including GHS).
Covered area/industrial sector	For fire departments and emergency responders of all industry sectors
Manufacturer/provider	knorre.android@gmail.com
Market availability	Yes, in GooglePlay
Indicative cost	Free
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions; Helps in identifying hazardous material □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies
Need of training to use the solution	No, as far as basic ICT skills are met.
Results and benefits	It is an easy handout of useful information for dangerous goods.
Technical limitation or applicability limitations	Android 2.3.2+
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	No variables
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Fatigue Predictor
Short description	Fatigue Management tool based on a commonly used fatigue model of calculating an Individual Fatigue Likelihood Score (IFLS). By setting the hours when slept/awake or on duty, Fatigue Predictor will automatically generate the IFLS prediction and flag duty limits. The app offers many parameters to adjust the calculations to specific Fatigue Risk Management System (FRMS) business rules. Activities are differentiated from normal to fatiguing. Corrections for sleep outside circadian rhythm can be implemented (for work schedules that cause major interruptions in a regular sleep pattern. Duty time can be tracked and max duty time limits and mandatory rest rules can be set up. Fatigue Assessments by users can be stored for comparison with the IFLS data for analysis and improvement of the settings. The Pro edition can be used in an organizational setting for multiple users/ employees and offers subscriptions to manage employees' Fatigue and Duty times. Employees can send the data to a cloud which can be retrieved by the organisation's administrator. IFLS and assessment data of all employees can be archived and retrieved. https://www.stoneproductions.com.au/FatiguePredictor2/index.html
Covered area/industrial sector	All industry sectors, particularly safety sensitive ones, such as aviation
Manufacturer/provider	Jan Steen Stone Productions, www.stoneproductions.com
Market availability	Yes, App Store
Indicative cost	$44,99
Licence	@STONE PRODUCTIONS
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The fatigue risk assessment offered by this app helps protect employees from sleep deprivation that is linked to difficulties in cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) The fatigue risk assessment offered by this app helps protect employees from sleep deprivation that affects negatively psychology and mental abilities. □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	  • New therapies Yoga, Taichi, Mindfulness
	  • Leisure programs
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity
	  • Leisure and sleep educational programs

Need of training to use the solution	Probably yes. Requires basic ICT skills.
Results and benefits	Not mentioned at website.
Technical limitation or applicability limitations	Requires iOS 9.0 or later. Compatible with iPhone, iPad and iPod touch.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Entered by user: hours engaged in a certain activity (or have slept). Data can be emailed or stored on cloud (for the Pro edition only).
Interoperability with other solution	X Yes □ No how? Data can be shared by mail or cloud repository. This will be checked after with WP4 and WP5 partners

General information	□ Technology X Application
Name of the application or technology	Incident cost calculator
Short description	This application uses sample accident and industry scenarios from a number of industries to calculate the financial cost of a workplace incident.
Covered area/industrial sector	All sectors
Manufacturer/provider	Workers' Compensation Board of British Columbia Standards https://gems.online.worksafebc.com/emailus
Market availability	Yes
Indicative cost	Free
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions X Sensory ability As to deterioration of relevant abilities related to workplace safety incidents. X Physical ability As to deterioration of relevant abilities related to workplace safety incidents. X Psychology/Mental abilities (including sleep problems) As to deterioration of relevant abilities related to workplace safety incidents. □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to use the solution	Not really, requires basic ICT skills and smart phone use.
Results and benefits	The application offers help in calculating costs for different health and safety accidents in various industries.
Technical limitation or applicability limitations	Requires iOS 5.0 or later. Compatible with iPhone, iPad, and iPod touch.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…)	N/A

retrievable via an API)	
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Calorie Counter- MyFitnessPal
Short description	It is a very popular health and fitness app. With: • Food database • Barcode scanner to log foods • Restaurant logging • Food insights • Personalized foods, recipes, meals, favourites and customized diary • Calorie counter • Macro and nutrients (calories, carbs, fat, protein, sugar, fibre, cholesterol, vitamins) tracker in foods and meals • Water tracking • Personalized goal setting and progress charting and monitoring • Exercise log
Covered area/industrial sector	All sectors, non-specific
Manufacturer/provider	525 Brannan Street San Francisco, CA 94107, androidfeedback@myfitnesspal.com
Market availability	Yes
Indicative cost	Free version, pay for add ons.
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability Health and fitness app to improve physical ability. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity
	  • Leisure and sleep educational program

Need of training to use the solution	No
Results and benefits	It is mentioned that over 200 million pounds have been lost by people that use the application and 88% of people who track for at least 7 days on MyFitnessPal lose weight.
Technical limitation or	Android phone needed.

applicability limitations	
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Logging by the user: cardio exercises, strength exercises, track steps, ability to connect with more than 50 apps and devices such as Fitbit, Jawbone UP, Garmin, MapMyFitness, Runkeeper, Strava, Runtastic, Misfit, Withings, HealthKit, UA Record and many more.
Interoperability with other solution	X Yes □ No how? With many fitness sensors through Bluetooth. This will be checked after with WP4 and WP5 partners

General information	□ Technology X Application
Name of the application or technology	Pill Reminder & Medicine Alarm- Pillbox
Short description	Medicine tracker app that reminds to take medicines punctually. The user can add medicine details like the time to take medicines, daily schedule, dosage, with or without food, doctor details, and medicine shapes and edit your medication schedule, add a new pill, remove existing prescription or replace it with a more actual one at any time you want.
Covered area/industrial sector	All sectors, non specific
Manufacturer/provider	android@smoothapps.me Flat/Rm 603, 6/F Laws Commercial Plaza 788, Cheung Sha Wan Road, KL
Market availability	No
Indicative cost	N/A
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability X Psychology/Mental abilities (including sleep problems) Helps to remind to take medicines punctually □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 4 Healthy habits programs • Vacuums and medical check (early prevention programs)
Need of training to use	No

the solution	
Results and benefits	Elderly medicated can benefit from the reminder tool to maintain adherence to treatment.
Technical limitation or applicability limitations	Requires Android 4.1 and up.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	N/A
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Safety compass
Short description	The Safety Compass uses intuitive augmented reality and interactive mapping to communicate hazard information to users in the field. By accessing the worker's physical location, the app presents vital information on present dangers straight to the worker's phone, avoiding the necessity of bulky safety manuals to locate and manage risk. Using the phone's inbuilt camera and GPS system, the app displays real and present dangers to the viewer that adapt and compensate for the viewer's field of vision.
Covered area/industrial sector	All sectors, especially high risk sites.
Manufacturer/provider	IntellectSEEC info@thesafetycompass.com.au
Market availability	Yes
Indicative cost	N/A Depends on working site
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions X Sensory ability Workers are able to easily access critical workplace safety information through detailed text, hyperlinks, pdf files and videos in dark, shifting, loud or crowded environments. Information usually stored in expansive manuals in site offices follows the viewer wherever they go, slashing the time and effort necessary to assess dangers in the workplace. □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to use the solution	Probably yes, depending on ICT skills
Results and benefits	Information is overlaid onto the workers camera view, providing detailed information on site conditions.
Technical limitation or applicability limitations	Requires android 4.4 and up. Uses phone camera and GPS
In case of an application: which variables does it gathers and in which way can we retrieve them?	User's location

(e.g. physical activity (steps, distance…) retrievable via an API)	
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Sling Calculator
Short description	Sling tension calculators, center of gravity calculators, volume and weight calculators. 9 different load shapes, 50 common materials, local units of measure available, horizontal or vertical angles ability to work. https://www.thecrosbygroup.com/resources/crosby-apps/ios/sling-calculator-free/
Covered area/industrial sector	Sectors with heavy lifts
Manufacturer/provider	The Crosby Group, app_support@theCrosbyGroup.com Regional contacts at: https://www.thecrosbygroup.com/contact-us/regional-contacts/
Market availability	Yes, App Store
Indicative cost	$24.99
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The application makes several calculations (sling tension, center of gravity, volume, weight) easier and quicker and provides direct reporting of the results in PDF format. □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies
Need of training to use the solution	Might need some training for those who are not familiar with smart phone use. Requires basic ICT skills, such as emailing and PDF files management.
Results and benefits	The app offers applications to aid in determining sling tensions, calculating a load's center of gravity and computing the volume and weight of a load.
Technical limitation or applicability limitations	Requires iOS 7.0 or later. Compatible with iPhone, iPad, and iPod touch.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	For determining sling tensions, load dimensions are defined by the user. For calculating the load's center of gravity, end weights of a given load must be specified or the locations and weights of up to four loads placed on a single pallet. For calculating the volume and weight of a load, materials dimensions must be indicated. Results are viewable in the app but can also be extracted in PDF and emailed to the user.

Interoperability with other solution	□ Yes X No

General information	□ Technology X Application (Google Fit is both a platform and an application)
Name of the application or technology	Google Fit
Short description	In general, Google Fit is a platform that supports the following: • Discovering sensors on users' devices (smartphones, smart-watches, activity trackers, other wearables or connected scales), such as 3-axis accelerometer, HR monitors, GPSs, scales, etc. • Collect data from these sensors regarding users' physical activity (e.g. walking steps) or physiological parameters (e.g. HR) • Store personal data in the Fitness Store, a cloud-based central repository service that is transparent to clients, and common to all Google Fit apps • Access data stored in the Fitness Store, including by other Google Fit compliant apps. This requires to manage a set of authorization scopes to request user permission to work with fitness data (Google Fit always requires user consent to access fitness data) • Access and manage users' "fitness history", to provide summaries, establish goals, send alerts, etc. The platform is part of an ecosystem, created in cooperation with other actors that develop devices, sensors and fitness apps (e.g. Lifesum, Wear OS by Google, Nike+, Runkeeper, Strava, MyFitnessPal, Lifesum, Basis, Sleep as Android, Withings, Xiaomi Mi Band). The platform can be accessed through two types of APIs: • Android APIs for Android apps • REST API for apps on any platform The Google Fit app is based on the Google Fit platform and provides users with a comprehensive view of their fitness, by applying the functions mentioned above. It also includes activity goals based on recommendations from the American Heart Association and the World Health Organization (i.e. move minutes and heart points). Google Fit terms of service establish that the platform can be used only for fitness applications (e.g. not for medical ones).
Covered area/industrial sector	Google Fit is agnostic with respect to the industry sector: it can be applied in any case where fitness management is important for workers.
Manufacturer/provider	Google LLC, 1600 Amphitheatre Parkway, Mountain View, CA 94043, US
Market availability	Yes Platform: https://developers.google.com/fit/ App: https://play.google.com/store/apps/details?id=com.google.android.apps.fitness
Indicative cost	Both the Google Fit platform and the Google Fit app are free
Licence	The usage of the Google Fit platform is regulated by specific terms of service: https://developers.google.com/fit/terms The usage of the Google Fit app is regulated by Google Play terms of service: https://play.google.com/intl/en-us_us/about/play-

	terms/index.html
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions • Forms of coaching are possible by using activity goals, activity recommendations, personalised plans or viewing and assessing activity history □ Sensory ability X Physical ability • Physical activity tracking • Physiological parameters tracking, depending on devices' available sensors (e.g. HR monitoring) X Psychology/Mental abilities (including sleep problems) • Sleep tracking is possible, depending on connecting Google Fit compatible sleep monitoring apps □ Workability

Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	No special training is needed to use Google Fit apps, although reviewing information on its function (e.g. on heart points and move minutes recommendations by the American Heart Association and the World Health Organization) is to be recommended.
Results and benefits	Benefits are mainly in terms of adoption and maintenance of healthy habits, particularly in terms of physical activity.
Technical limitation or applicability limitations	Google Fit is not endorsed as a medical application.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Detected variables depend on sensors and other Google Fit compliant apps which are connected. The most common ones are: • Steps • Kcal burned • Distance • Heart rate • Weight A list of standard variables can be found here: https://developers.google.com/fit/android/data-types#public_data_types However, Google Fit apps can also: • Support custom variables (https://developers.google.com/fit/android/data-types#custom_data_types) • Propose sharable variables

	• (https://developers.google.com/fit/android/data-types#shareable_data_types) • Ask for access to restricted sensitive health variables (https://developers.google.com/fit/android/data-types#restricted_data_types) • Access raw data from sensors (https://developers.google.com/fit/android/sensors) • Support additional sensors (https://developers.google.com/fit/android/new-sensors)
Interoperability with other solution	X Yes (partially) □ No Interoperability is possible with other Google Fit compatible apps

General information	□ Technology X Application
Name of the application or technology	Lifesum - Diet Plan, Macro Calculator & Food Diary
Short description	Diet plan, food diary, macro calculator, calorie counter & healthy recipes in one app. Meal planner & macro tracker - TOP Lifesum features: • Diet plan & diet tips for any goal • Keto, vegan, 5:2 and more diets & plans • Calorie counter & food tracker with barcode scanner for easy logging • Macro calculator • Physical activity tracker • Food planner • Health tracker Nutrition data as well as physical activity data are being entered manually by the user.
Covered area/industrial sector	General use
Manufacturer/provider	support@lifesum.com Lifesum AB Klarabergsviadukten 90 Box 162 101 23 Stockholm Sweden
Market availability	Yes
Indicative cost	Depending on the version: free (calories and nutrition tracking as well as physical activity tracking) or premium version (diet plans, diet tips, habit tracker, recipes, food planner, macro calculator, health tracker, body composition, LifeScore - weekly score on health, based on 16 nutrition and exercise measurements accompanied with tips and recommendations on how to improve) from 3.33 EUR/month
Licence	If available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – helps to lose weight and to improve nutrition habits as well as to increase physical activity □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4: Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	Rather not, but depends on ICT skills

Results and benefits	Not available
Technical limitation or applicability limitations	For Android and IOS
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Nutrition (macros, calories) and exercise (type and duration) data as well as user's health data (weight) can be exported. http://api.lifesum.com/mobile-terms
Interoperability with other solution	X Yes □ No How? Lifesum integrates with Google Fit and S Health, so one can export nutrition and exercise data from Lifesum to Google Fit and S Health, and import fitness data and weight and body measurements back to Lifesum. Syncs with fitness apps such as Moves, Nokia Health, FitBit, Jawbone, Endomondo and Runkeeper (premium version).

eneral information	□ Technology X Application
Name of the application or technology	Tap into safety
Short description	Two workplace health and safety training solutions within one platform. These solutions can include over 28 pre-built modules or the team of in house developers and designers can customise versions specific to user's organisation. Workplace Safety Training Solution Using specific organisations existing workplace health and safety data to build an individualised, interactive and immersive hazard perception training solution to complement existing workplace training. Cloud-based interactive training modules can be completed in under 15 minutes and are available online and via smart devices. Through using 360-degree panoramic photography the workplace safety training solution allows staff to interact with the gaming platform to determine if there are any gaps in their safety knowledge. This allows organization to assess, measure and improve hazard perception through detailed results and reports. Available modules: • Access and egress and roll away hazards • Civil works and traffic management • Commercial kitchen • Dispatch yard • Falls from height: multi-story construction • Falls from height: residential construction • Main roads WA sign erection requirements • Maintenance workshop • Mechanical workshop • Minor capital works • People and plant • Plant worker interface road resurfacing • Road spray sealing • Roadside vegetation management • Scaffolding: under and on • Tunnel maintenance • Traffic control • Office • Warehouse Reporting platform is a diagnostic tool, that provides management with an understanding of the safety knowledge retained from training. Use to trend and showcase the gaps in knowledge.

	Workplace Mental Health Training Solution Mental health training solution provides organisation with animated customised scenarios of typical workplace issues that can impact on the mental health of the worker. It trains staff to know what, and what not to do in common workplace situations that can impact negatively on mental health. It softens barriers and encourages engagement by having staff play through animated workplace scenarios. By guiding staff through the scenarios, strategies are offered and mental health understanding is improved through using the solution. The non-invasive delivery encourages staff to seek help that can be accessed 24/7 with direct links to EAP. The solution combines these scenarios with a personal and anonymous mental health quiz that assesses stress, anxiety and depression levels. The reporting platform tracks these levels across given organisation. The analytical data draws comparisons within the organisation and compares results with the general population. Pre-built modules: • Workplace bullying • Alcohol and depression • Relationship breakup • Change and burnout • Self-harm and suicide • Sexual harassment • Illicit drug use • Fifo – transition to home • Fifo – away at key times • Grief and loss
Covered area/industrial sector	All sectors (possible customizing the content by tailoring to organisation's needs), including warehouse and plant workers
Manufacturer/provider	https://www.tapintosafety.com.au/contact/ Perth (Head Office) 08 9243 4545 +61 408 882 353 Sydney +61 420 242 783 Melbourne +61 420 236 977
Market availability	Yes
Indicative cost	Depending on number of staff (minimum 20 users) and monthly (3$/user)

	or annually (2.5$/user) billing
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability - safety training aims on prevention of occupational hazards and injuries, maintaining employees health X Psychology/Mental abilities (including sleep problems) - mental health module tackles mental health issues help in to prevent and deal with them □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Learning and training tools and technologies • Domain 3: Improving productivity and workability
Need of training to use the solution	Rather not but depending on ICT skills (computer or smart devices use)
Results and benefits	10% reduction in injuries, 75% reduction in equipment damage frequency (in clients using safety training) - information from the website, no more details available
Technical limitation or applicability limitations	Available online and via smart devices
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	It doesn't gather any variables, it is an online health&safety training
Interoperability with other solution	X Yes □ No How? - URL integration enables use within organisation's current Safety Induction and Workplace Safety Training

General information	□ Technology X Application
Name of the application or technology	Ada - Your Health Guide
Short description	Based on symptoms entered and answers to the questions, this app suggest diagnosis, describes risks, treatment, prevention, prognosis and next steps. User can also share their health data with their doctor and share as PDF with their contacts. This app gets to know the user and gives health information specific to them (e.g. sex, age). Personalized interactive chat - Ada asks simple, relevant questions and compares users' answers to similar cases to help find possible explanations for their symptoms. The app includes 10,000 symptoms and diseases (from skin problems to mental health issues). Besides the interactive chat, this app offers a conditions library with patient-friendly medical information. Partnering with government institutions, companies and other industry stakeholders this app have received grants such as the EU's Horizon 2020 Programme. English, German, Spanish, Portuguese and French language version available.
Covered area/industrial sector	General use
Manufacturer/provider	hello@ada.com Ada Health GmbH Adalbertstrasse 20 10997 Berlin Germany
Market availability	Yes, Google Play, App Store
Indicative cost	Free of charge
Licence	If available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions X Sensory ability - symptoms can concern hearing or vision problems. This app diagnoses these problems and proposes further actions. X Physical ability - symptoms can concern physical ability issues. This app diagnoses these problems and proposes further actions. X Psychology/Mental abilities (including sleep problems) - symptoms can concern mental health problems. This app diagnoses these problems and proposes further actions. □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 4: Healthy habits programs • Vacuums and medical check (early prevention programs)

Need of training to use the solution	Depending the ICT skills but the app is quite user-friendly.
Results and benefits	Not available
Technical limitation or applicability limitations	Operates with Android (4.4 or newer) or iOS
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Health info can be shared. Upon request the source code of the free and open source components on a data-medium may be supplied. Contact: Ada Health GmbH, Adalbertstr. 20, D-10997, Berlin, Germany. hello@ada.com
Interoperability with other solution	X Yes □ No How? By using the open source code.

General information	□ Technology X Application
Name of the application or technology	Daily Yoga - Yoga Fitness Plans
Short description	Daily Yoga offers 500+ asanas, 50+ yoga class plans, 200+ guided yoga, pilates, meditation classes plus yoga pose base that suit yogis from beginner to advanced. Focused on yoga for weight loss, beginner to advanced, better sleep & full relax. Highlights: - 50+ Yoga class plans & workshops for Beginner to Advanced, Getting Toned and Wellness - 500+ yoga poses with detailed voice instructions - 200+ yoga classes with HD video updated monthly - Multiple choices for session duration varied from 5 - 70 mins - Stay on track with your health data - Specially designed meditations with online coach guide - Yoga post daily with a supportive community - 7 languages available worldwide (English, Japanese, Korean, Spanish, Chinese, German, French) More: - Various meditation music/yoga music/relax melodies available - Scheduled plans for boot camp, body toning, weight loss, strength, flexibility, relaxation, balance, menstruation, body detox, meditation etc. altogether with 10+ experts - Google Fit support
Covered area/industrial sector	Health & Fitness, General use
Manufacturer/provider	Daily Yoga is a registered trademark of Daily Yoga Culture Technology Co. Ltd. Customer Service : Support@dailyyoga.com Partners : Partners@dailyyoga.com Daily Yoga Software Technology Co. Ltd. 22nd Floor, Rong Cheng Yun Gu Building B, No.57 Keji 3rd Road, Gaoxin District, Xi'an, Shaanxi China, 710075
Market availability	Yes, Google Play and App Store

Indicative cost	Free, Paid and Pro versions Free: 10 trainings for different body parts, one training plan (12 days for beginners) Various payable programs, including Mindfulness program, from 9,99$ do 29,99$ Pro: unlocking yoga classes and plans right away. 9.99$ /month, 59,88$/year, 199$/lifetime (adds-free)
Licence	Daily Yoga is a registered trademark of Daily Yoga Culture Technology Co. Ltd.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – Exercises focused on weight control, body sculptor; HIIT, Pilates & Vinyasa applied for more fat burned; Tracking calories and workout time helps with planning physical activity X Psychology/Mental abilities (including sleep problems) – mindfulness classes should improve mental abilities and wellbeing by decreasing stress level □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 3: Improving productivity and workability • New therapies Yoga, Taichi, Mindfulness
Need of training to use the solution	If low ICT skills
Results and benefits	Not available
Technical limitation or applicability limitations	Available for iOS (iPhone, iPad, Apple Watch) and Android (requires Android 4.0.3 or newer)
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Tracking calories and workout time with health data chart, Apple Health supported
Interoperability with other solution	X Yes □ No how? Through Apple Health and Google Fit

General information	□ Technology X Application
Name of the application or technology	dB Volume Meter
Short description	dB Volume Meter provides a simple way to measure audio volumes in users' environment. The app shows the approximate dB (decibel) level, also known as Sound Pressure Level (SPL). This app is mainly intended for fun, educational purposes, not for professional-level volume measurements, for which one should buy an actual SPL meter. This dB meter design has a darker display with a bright, colorful dB indicator, with the extra feature of slow/fast response to see a more gradual dB response. Included are statistics about the measured volumes, including Average, Peak, Peak Hold, current dB level, maximum, and minimum values. This application requires an external microphone for use with the iPod Touch.
Covered area/industrial sector	General use (not professional)
Manufacturer/provider	Amanda Gates
Market availability	Yes
Indicative cost	$0.99
License	Not available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions X Sensory ability - this app measures dB level and thus could protect hearing from excessive noise □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 4: Healthy habits programs
Need of training to use the solution	Depends on ICT skills
Results and benefits	Not available
Technical limitation or	Operating system: iOS only

applicability limitations	
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	No information available
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Endomondo
Short description	Endomondo is designed to track users' workouts, provide audio feedback along the way and offer guidance on how to reach users' goal. It syncs with Endomondo.com, where you can access a full training log and analyze your fitness activity. Free features: • Real-Time GPS Tracking and Live Map • Audio Coach Feedback • Workout History • Workout Goals • Tagging and Pictures • Heart Rate Sensors when connecting the app with external heart rate monitor • App Customization • Customize your workout screen with data such as distance, duration, pace, heart rate, calories etc. • Multiple Sports tracking • Music • Global Fitness Community • News Feed • Pep talks from friends • Challenges • Routes • Sharing results on Facebook, Google+ and Twitter Premium features: • Training Plan • Advanced Statistics with #Tags • Interactive Graphs • Interval Training • Heart Rate Zones • Weather Information • Extra Workout Goals • Personal Best History • Workout Comparison • Ad Free • VIP Support
Covered area/industrial sector	General use

Manufacturer/provider	Endomondo Kanonbådsvej 12B 1437 Copenhagen K Denmark support@endomondo.zendesk.com
Market availability	Yes
Indicative cost	Depending on the version: free or USD 29,99/year, USD 5,99/month
Licence	Endomondo LLC / Under Armour (Owner)
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – tracks sport activities motivating to physical activity and physical ability enhancement □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4: Healthy habits programs
	  • Physical activity

Need of training to use the solution	Yes, if low ICT skills
Results and benefits	Not available
Technical limitation or applicability limitations	For Android and iOS
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Distance, duration, pace, calories retrievable via API (e.g. unofficial API https://github.com/fabulator/endomondo-api)
Interoperability with other solution	X Yes □ No Endomondo is integrated with a wide range of watches and sensors in order to enhance the user experience and provide them with more comprehensive workout data, such as heart rate stats: Jabra, Garmin, myfitnesspal, Polar, Timex, wahoo fitness, withings, Zephyr, Fitbit, Suunto.

General information	□ Technology X Application
Name of the application or technology	FitToFit - Fitbit to Google Fit
Short description	Transfers fitness data from Fitbit to Google Fit
Covered area/industrial sector	General personal use
Manufacturer/provider	tietze.development@web.de Tom Tietze
Market availability	Yes https://play.google.com/store/apps/details?id=fitapp.fittofit
Indicative cost	Free download
Licence	If available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – this application is aimed at transferring fitness data between applications so it is aimed at tracking and improving physical health □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4: Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	Yes
Results and benefits	Information not available
Technical limitation or applicability limitations	This application helps to transfer measurement data from FitBit wristband to Google Fit - a health-tracking platform developed by Google for the Android operating system and Wear OS (Google's Android operating system designed for smartwatches and other wearables). It means it can be used by FitBit and Google Fit users only.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	FitToFit can transfer data from FitBit regarding: - steps - activities - distances - heart rate - sleep - weight - body fat - food

	- water API https://www.apkmirror.com/apk/tom-tietze/fittofit-fitbit-to-google-fit/fittofit-fitbit-to-google-fit-5-1-release/fittofit-fitbit-to-google-fit-5-1-android-apk-download/
Interoperability with other solution	X Yes □ No With FitBit and Google Fit

General information	□ Technology X Application
Name of the application or technology	Health Mate - Total Health Tracking
Short description	Enable to view and track health, such as weight, steps, calories burned, heart rate and more. This app combines the data from several devices and services: Fitbit, Microsoft Health, Withings — Activity tracking — Leader board motivation: Links friends and family — Badges: rewards for progress — Heart rate — Blood pressure — Sleep cycles — Smart Wake-Up™: Wakes up at the optimal point in user's sleep cycle — Weight, BMI, and Full Body Composition, plus weight trends — Motivation with in-app rewards — Can log manually, or have information auto-sync via connected scales range — Sleep smarter: Shows how getting more consistent sleep can improve health and support weight loss efforts. — Better body: teaches about body composition and new ways to lose fat — forever in 6-week program. — Pregnancy tracker: personalized obstetrician-reviewed advice, tips, and weight tracking throughout pregnancy. — Meditation program (depending on the connected devices – smart watches, scales, pressure gauge etc.)
Covered area/industrial sector	General use
Manufacturer/provider	android@withings.com Withings 2 Rue Maurice Hartmann 92130 Issy-les-Moulineaux France
Market availability	Yes
Indicative cost	Free
Licence	If available

Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – activity tracking, physical health parameters X Psychology/Mental abilities (including sleep problems) – meditation program available □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 3: Improving productivity and workability
	  • New therapies Yoga, Taichi, Mindfulness
	• Domain 4: Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	Yes, but depending on ICT skills
Results and benefits	Not available
Technical limitation or applicability limitations	Available for Android and iOS (Requires iOS 10.0 or later. Compatible with iPhone, iPad, and iPod touch) External sensing devices needed (watches, scales, health monitors) Language versions: English, Dutch, French, German, Italian, Japanese, Korean, Portuguese, Russian, Simplified Chinese, Spanish
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Steps, distance, calories burned, total calories Heart Rate zones, duration, calories burned, fitness level via VO2Max and GPS path (depending on external sensing devices: smart watches, scales, health monitors)
Interoperability with other solution	X Yes □ No This app combines the data from several devices and services: Fitbit, Microsoft Health, Withings. Health Mate links with 100+ top health and fitness apps including Apple Health, Nike, RunKeeper & MyFitnessPal.

General information	□ Technology X Application
Name of the application or technology	Heart Trace 2
Short description	Heart Trace automatically checks heart rate at regular intervals via your Android Wear smartwatch and syncs heart rate data with Google Fit. Users can view their heart rate by the day, hour or minute or as a daily summary. Features: • Automatic monitoring heart rate • Viewing all data by the day, hour or minute. • Syncing heart rate readings to Google Fit. • Exporting readings to a CSV file. • Sports mode - continuously monitoring heart rate. Permissions required by this application • Body sensors - enables heart rate detection. • Storage - enables export data to CSV.
Covered area/industrial sector	Health & Fitness, General use
Manufacturer/provider	magic09.apps@gmail.com magic09 applications, Office 11694, PO Box 15113, Birmingham, B2 2NJ
Market availability	Yes
Indicative cost	Free
Licence	If available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – monitoring heart rate and viewing results by the day, hour or minute or as a daily summary. □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas
	• Domain 4: Healthy habits programs
	  • Physical activity
	  • Vacuums and medical check (early prevention programs)

Need of training to use the solution	Yes, if low ICT skills
Results and benefits	Not available
Technical limitation or	This app requires an Android Wear smartwatch with a heart rate sensor.

applicability limitations	User also needs to connect to Google Fit account to enable syncing of heart rate readings.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Heart rate Not sure about retrieving the data. The app is still in development and the developer is eager to cooperate: https://plus.google.com/communities/101781392757311833259
Interoperability with other solution	□ Yes □ No how? Information not available.

General information	□ Technology X Application
Name of the application or technology	Step Counter - Pedometer Free & Calorie Counter
Short description	This pedometer uses the built-in sensor to count steps. No GPS tracking, so it can greatly save battery. It also tracks burned calories, walking distance and time, etc. All this information will be clearly displayed in graphs. Features: Save Power; No locked Features (All features are 100% free); No sign-in required; Report Graphs (user can check last 24 hours', weekly and monthly statistics in graphs); Backup & Restore Data from Google drive.
Covered area/industrial sector	Fitness app, general use
Manufacturer/provider	northpark.android@gmail.com UNIT047/F, BRIGHT, WAY TOWER, NO.33 MONG KOK ROAD KOWLOON Hong Kong Box 957
Market availability	Yes, Google Play
Indicative cost	Free version or Premium version (without adds) 9,99 PLN
Licence	Google Commerce Ltd (?)
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – counts steps and burned calories motivating to walk more, improving physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas (according literature) (select one or more and delete the others) • Domain 4: Healthy habits programs • Physical activity
Need of training to use the solution	If low ICT skills
Results and benefits	Not available
Technical limitation or applicability limitations	Requires Android 4.1 and up
In case of an application: which variables does it gathers and in which way can we retrieve them?	Steps, burned calories, walking distance and time No info available

(e.g. physical activity (steps, distance…) retrievable via an API)	
Interoperability with other solution	□ Yes □ No No info available

General information	□ Technology X Application
Name of the application or technology	Aqualert
Short description	Water/hydration tracker and reminder Features: Notifications; Water Intake calculator with users' gender, weight and activity level; Tracker and Reminder with automatic bed time mode; Graphical display of users' hydration level and daily consumption; Charts and indicators; Customize serving; Messages to encourage to drink more water.
Covered area/industrial sector	General personal use
Manufacturer/provider	contactus@aqualertapp.com 61a Eton Avenue Swiss Cottage, London, NW3 3ET United Kingdom; Google Commerce Ltd seller of Aqualert Premium (no commercials version)
Market availability	Yes
Indicative cost	Free download or 7.99 PLN for premium version
Licence	Not available
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability X Physical ability – the application is used for tracking users' hydration motivating them to take care of the water intake, improving physical health □ Psychology/Mental abilities (including sleep problems) □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 4: Healthy habits programs • Nutrition
Need of training to use the solution	Yes, if low ICT skills
Results and benefits	Not available
Technical limitation or applicability limitations	Entering the amount of water drunk manually - requires user's attention and willingness to enter. For Android and Apple
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…)	Amount of water/hydration based on manually entered data contactus@aqualertapp.com

retrievable via an API)	
Interoperability with other solution	X Yes □ No Through Google Fit

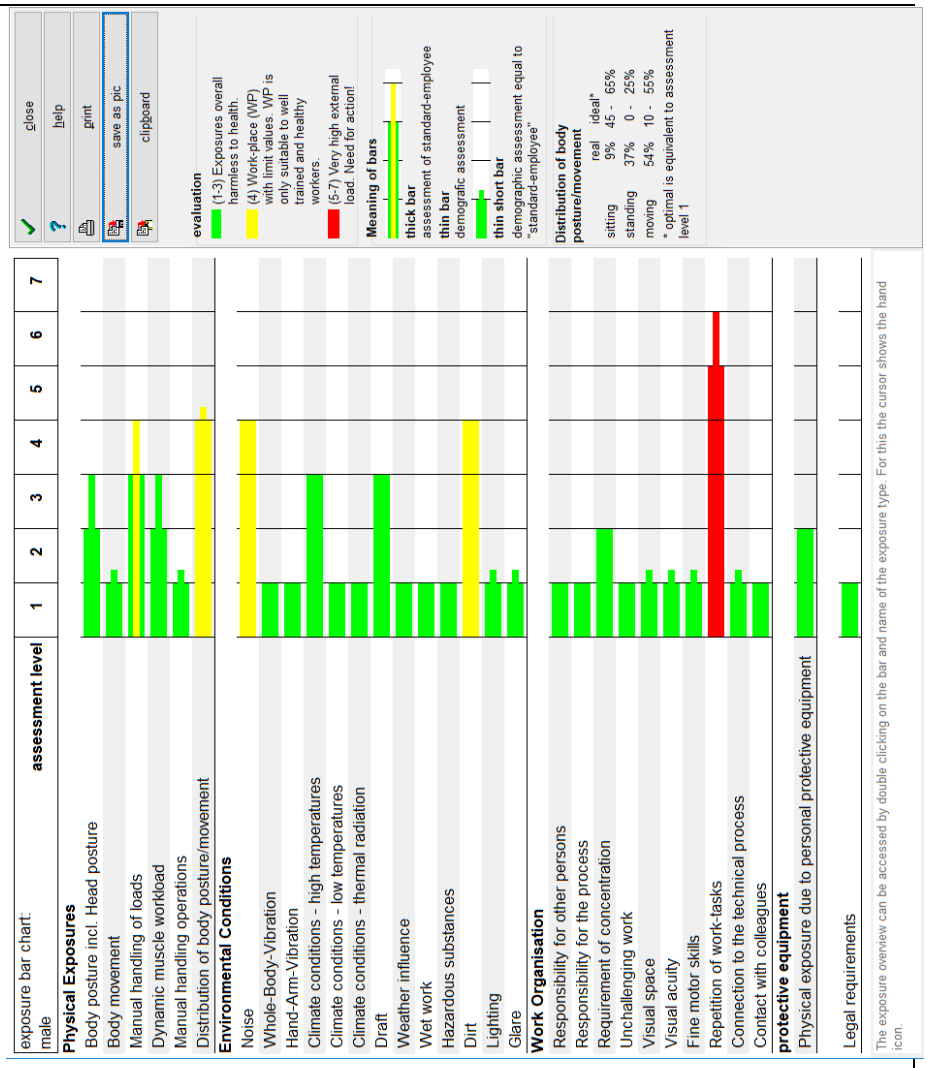
General information	□ Technology X Application
Name of the application or technology	BAB/BDS (Belastungs-Dokumentations-System [Exposure-Documentation-System])
Short description	The multilingual "Belastungs-Dokumentations-System [Exposure-Documentation-System] (BDS)" based on the occupational science procedure "Beurteilung arbeitsbedingter Belastungen [Assessment of work-related exposures] (BAB) " supports companies in occupational health management, occupational integration management, the simulation of future work systems and the assessment and design of working conditions , demographic change and the safeguarding of skilled workers during operation. The BAB/BDS method supports organizations effectively, efficiently and management-related in the planning and design of future work systems and in the assessment of the working conditions of existing work systems as well as in the control and controlling of these tasks at the level of operational management. • Modular system for the holistic ergonomic (risk) assessment and improvement of work systems. • Assessment is based on a digital human model for (average) younger and older, male and female employees. In addition, the requirements of special groups of employees can be taken into account. • Special focus on demographic aspects and older employees. • Supports an ageing- and age-appropriate work design. • Systematic description of workflow and assessment of working conditions in more than 30 items on a 7-point scale. Additional illustration of the results by a traffic light model. • The results are presented as an exposure bar chart that illustrates the "ergonomic quality" of a work system. • All activities carried out during a typical working day are charged to a common risk score. • Based on nationally and internationally recognized procedures and scientific findings. • Consideration of ergonomic and other relevant aspects already in the planning phase of work systems. • Through numerous analysis options, the results can be operationalized and used for identification of potential for improvement and to support a continuous improvement process. • Specific KPIs (e.g. age-stability rate, physical/mental overload rate) support management in planning and effectiveness control. • Supports occupational integration and health management. • Local version and network version available.

	• Multilingual Basic modules: • Physical exposures (e.g. load handling) • Environmental conditions (e.g. noise) • Work organisation / mental and psychosocial exposures (e.g. cycle times) • Physical exposure due to personal protective equipment (PPE) Additional modules: • Maternity protection • Accident hazards • Extended module on mental and psychosocial exposures
Covered area/industrial sector	Applicable in all industrial sectors, main focus on blue collar work. There are operational experiences in different branches of industry, e.g.: • iron and steel industry • glass and ceramic industry • rubber industry • electronics industry • tool manufacturing • etc.
Manufacturer/provider	Scientific and Technical Consulting Ltd. (GEWITEB) Corneliusstrasse 31 42329 Wuppertal Germany Mail: info@gewiteb.de Internet: www.gewiteb.de *System basics and scientific backgrounds:* *Institute of Occupational Health, Safety and Ergonomics (ASER) e.V.* *Corneliusstrasse 31* *42329 Wuppertal* *Germany* *Internet: www.institut-aser.de*
Market availability	Yes. Under https://www.institut-aser.de/out.php?idart=542 a simplified online version of the BAB / BDS is available. https://www.gewiteb.de/out.php?idart=21 https://www.institut-aser.de/out.php?idart=265
Indicative cost	Price on request and according to customer requirements
Licence	Price on request and according to customer requirements
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions X Sensory ability X Physical ability

	X Psychology/Mental abilities (including sleep problems) X Workability Assessment is based on a digital human model for average younger and older, male and female employees, taking into account data on relevant performance indicators, skills and abilities. The items queried in the method address all of the problem areas mentioned.

Domain/type of solution	• Domain 1: Policy for older workers
	  • One focus of the method is the consideration of age-changing work requirements. It is possible to specifically identify work systems that are suitable for older employees.
	• Domain 2: Increasing job retention (postponing early retirement)
	  • Increasing job retention through humane work design
	• Domain 3: Improving productivity and workability
	  • Improving productivity and workability through humane work design
	  • Improving productivity and workability optimal use of skills and abilities
	• Domain 5 Adaptation and compensatory mechanisms
	  • To adapt work environment to aging functional decline
	  • To adapt work environment to chronic illness or diseases

Need of training to use the solution	Yes, basic training of 3-5 days needed (depending on previous knowledge)
Results and benefits	Basic result is an exposure bar chart which indicates the risk of an overload and adverse health effects in more than 30 items (Modular system, number of relevant items varies).

	 On company level, overall results can be operationalized and used for identification of potential for improvement and to support a continuous improvement process. It can be specifically searched for jobs that match the performance requirements of certain employees. *For more information see best practice "Ergonomics and Demographics Program @ Continental" provided by ASER.*
Technical limitation or applicability limitations	Available for Windows, implementation for Android and iOS conceivable.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity	Gathers numerous variables describing work schedule, workflow and working conditions (e.g. work energy consumption, load weights, handling frequencies, noise level, climate, etc.) Generates risk scores for all included items and an exposure bar chart

(steps, distance…) retrievable via an API)	describing "ergonomic quality" of every included work system and numerous other data. From a technical point of view, the input parameters and results can be exported (for example in Excel) and used elsewhere.
Interoperability with other solution	X Yes □ No how? This will be checked after with WP4 and WP5 partners

General information	□ Technology X Application
Name of the application or technology	BBM/BiFra (Verfahren zur Beurteilung und Gestaltung von Büro- und Bildschirmarbeit sowie Mobiler Arbeit [Method for assessing and designing office and computer work as well as mobile work])
Short description	The BBM method from 2017 is the comprehensive further development of the fully web-based and interactive instrument of the Bildschirm-Fragebogen [Screen questionnaire] (BiFra) since the mid-1990s.The BBM method supports organizations effectively, efficiently and management-related in the planning and design of future work systems and in the assessment of the working conditions of existing work systems as well as in the control and controlling of these tasks at the level of operational management. The basic BBM method takes into account relevant aspects for office and computer workstations such as • work organisation, • workplace and equipment, • working environment, • software and • health protection. The professional BBM method also takes into account • design of work tasks / work contents, • teleworking, • mobile work, • working times, • leadership, • inclusion, • physical measurements and • measures of work design. It is a web-based method that first allows the employee to self-assess the applicable working conditions. The single result shows design deficits and gives hints for improvement. The analysis of the database enables individual protocols for each individual workstation as well as vulnerability analyzes over the entire data stock as well as any subset of the data records. In vulnerability analysis, the selected data set can be contrasted with the 18,000 data sets collected so far with the instrument. Thus, a comparison to the previously available reference data sets is possible for each question.
Covered area/industrial sector	Office work, computer work, teleworking, mobile work.
Manufacturer/provider	The method was developed by the *Institute of Occupational Health, Safety*

	and Ergonomics (ASER) e.V. The *Scientific and Technical Consulting Ltd. (GEWITEB)* offers the individual adaptation of the BBM method. Scientific and Technical Consulting Ltd. (GEWITEB) Corneliusstrasse 31 42329 Wuppertal Germany Mail: info@gewiteb.de Internet: www.gewiteb.de Institute of Occupational Health, Safety and Ergonomics (ASER) e.V. Corneliusstrasse 31 42329 Wuppertal Germany Mail: info@institut-aser.de Internet: www.institut-aser.de
Market availability	Yes https://www.institut-aser.de/out.php?idart=262 https://www.gewiteb.de/out.php?idart=22 Under https://www.institut-aser.de/out.php?idart=485&oc=on#tab1 a simplified version of BBF/BiFra is available.
Indicative cost	Price on request and according to customer requirements
Licence	Price on request and according to customer requirements
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions The results show deficits at individual workplaces and hints are given for better design / optimization. This supports learning among the employees concerned. The analysis of the whole data stock of a company or an organizational unit can show general design deficits. X Sensory ability X Physical ability X Psychology/Mental abilities (including sleep problems) X Workability The items queried in the method address all of the problem areas mentioned.

Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
	  • Increasing job retention through humane work design
	• Domain 3: Improving productivity and workability
	  • Improving productivity and workability through humane work design
	  • Improving productivity and workability optimal use of skills and abilities

Need of training to use the solution	For the application by the user (completing the online questionnaire) no training is required. Training is needed to use the advanced analysis features.
Results and benefits	The single result shows design deficits and gives hints for improvement. The analysis of the database enables individual protocols for each individual workstation as well as vulnerability analyzes over the entire data stock as well as any subset of the data records. In vulnerability analysis, the selected data set can be contrasted with the 18,000 data sets collected so far with the instrument. Thus, a comparison to the previously available reference data sets is possible for each question.
Technical limitation or applicability limitations	It is web based.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Collects various data that characterizes the working system at a descriptive level. From a technical point of view, the input parameters and results can be exported (for example in Excel) and used elsewhere.
Interoperability with other solution	X Yes □ No Results and inputs can be exported in excel. This will be checked after with WP4 and WP5 partners

General information	□ Technology X Application
Name of the application or technology	Ergonomics
Short description	"Ergonomics is a complete mobile workplace health solution that offers equipment setup advice, a variety of workplace specific stretching exercises, and programmable reminders to help you time your breaks. […]" https://itunes.apple.com/us/app/ergonomics/id547689680
Covered area/industrial sector	Office work
Manufacturer/provider	Stand Up Apps, Inc.
Market availability	Yes, available on the App Store for iOS devices
Indicative cost	1,09€
Licence	No information
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions • Information on setup of (office) workplace and equipment o Learn how to setup your desk, chair, monitor, mouse, and keyboard for enhanced productivity. o Quick tips give you a summary of the setup at a glance. o Detailed setup information supported by OSHA (Occupational Safety and Health Administration). □ Sensory ability X Physical ability • programmable reminders to help time breaks o Gentle reminders are "opt-in" and are designed to be non-obtrusive. o Reminders are customizable to fit into your individual work schedule. • acitivity tracking o sitting or moving? o No detailed information available • stretching exercise o All stretches feature original illustrations and instructions on how to properly position your body. o You can choose between individual stretches or a group of stretches targeting a specific area. o A countdown timer is included to help you properly time your stretches. □ Psychology/Mental abilities (including sleep problems)

	X Workability • Physical and ergonomic work environments are often better adopted among older workers than among younger workers.

Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4 Healthy habits programs
	  • Physical activity

Need of training to use the solution	No
Results and benefits	Developer promises: "Incorporating this application into your daily routine will leave you feeling happier, healthier, and more energized." Awards: Winner of the People's Choice Award for the Department of Labor App Challenge! Reached #7 in the Productivity section of the App Store!
Technical limitation or applicability limitations	Requires iOS 7.0 or later. Compatible with iPhone, iPad, and iPod touch. Languages: English, Arabic, Catalan, Czech, Danish, Dutch, Finnish, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Malay, Norwegian Bokmål, Polish, Portuguese, Romanian, Russian, Simplified Chinese, Slovak, Spanish, Swedish, Thai, Traditional Chinese, Turkish, Vietnamese
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	No detailed information available
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	First Aid - American Red Cross
Short description	"The official American Red Cross First Aid app puts expert advice for everyday emergencies in your hand. Get the app and be prepared for what life brings. With videos, interactive quizzes and simple step-by-step advice it's never been easier to know first aid." https://play.google.com/store/apps/details?id=com.cube.arc.fa&hl=en
Covered area/industrial sector	Any work or situation
Manufacturer/provider	American Red Cross 2025 E Street, NW Washington, DC 2000 mobile@redcross.org http://www.redcross.org
Market availability	No (not available in Europe only in USA)
Indicative cost	The app is free.
Licence	N/A.
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions Easy to use Spanish language toggle to switch translation directly inside the app. · Heat stroke and related content now included in learn and emergency tabs · Simple step-by-step instructions guide you through everyday first aid scenarios. · Fully integrated with 9-1-1 so you can call EMS from the app at any time. · Videos and animations make learning first aid fun and easy. · Safety tips for everything, from severe winter weather to hurricanes, earthquakes and tornadoes help you prepare for emergencies. · Preloaded content means you have instant access to all safety information at any time, even without reception or an Internet connection. Interactive quizzes allow you to earn badges that you can share with your friends and show off your lifesaving knowledge. □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	• Domain 4 Healthy habits programs
	  • Safety tips for everything, from severe winter weather to hurricanes, earthquakes and tornadoes help you prepare for emergencies.
	• Domain 5 Adaptation and compensatory mechanisms
	  • Simple step-by-step instructions guide you through everyday first aid scenarios

Need of training to use the solution	No.
Results and benefits	Safety tips for emergencies, and simple step-by-step instructions guide you through everyday first aid scenarios
Technical limitation or applicability limitations	Not available in Europe. Requires Android 5.0 and up.
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	This app has access to: Location • approximate location (network-based) • precise location (GPS and network-based) Photos/Media/Files • read the contents of your USB storage • modify or delete the contents of your USB storage Storage • read the contents of your USB storage • modify or delete the contents of your USB storage Other • receive data from Internet • view network connections • full network access • prevent device from sleeping There is no way to retrieve the information of the app.
Interoperability with other solution	□ Yes x No

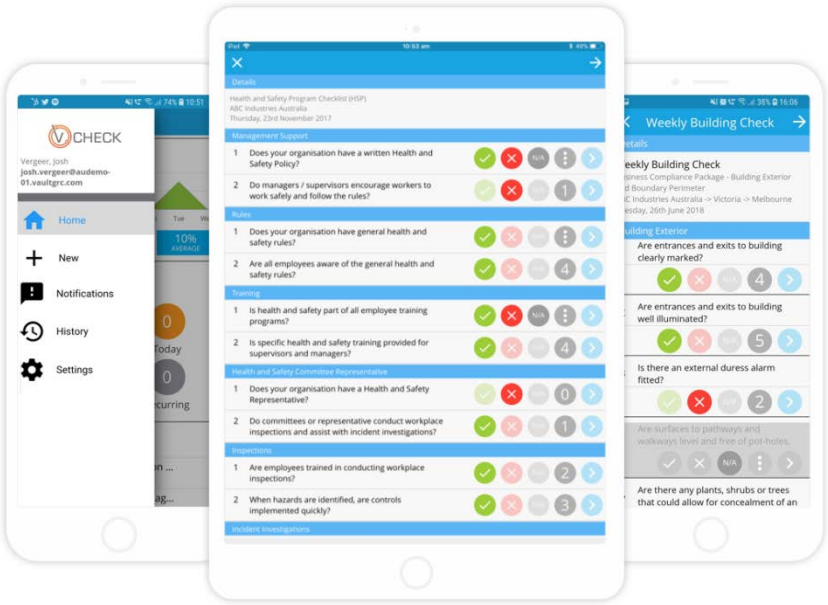
General information	□ Technology X Application
Name of the application or technology	Behavior Change Techniques in mHealth Apps for the Mental and Physical Health of Employees: Systematic Assessment
Short description	Systematic review / assessment of 45 mHealth Apps for the Mental and Physical Health regarding 26 Behavior Change Techniques (BCT) List of BCT: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231882/bin/mhealth_v6i10e167_app1.pdf
Covered area/industrial sector	Wide range of occupational setting
Manufacturer/provider	Different providers
Market availability	Yes. 13 were found in Google Play, 22 in Apple App Store, and 10 were found in both
Indicative cost	"Of the 45 apps, 13 (29%) had to be paid for with a mean price of €2.40 (range €0.99-4.99). Twenty-nine apps (64%) were free, and 3 (7%) apps had an access code. This access code was used when the app was offered as part of a company program. These apps are not free; however, the cost of these apps is unknown." (de Korte et al. 2018 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231882/#app1)
Licence	N/A
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability x Physical ability Assessment of 45 mHealth Apps for the Mental and/or Physical Health x Psychology/Mental abilities (including sleep problems) Assessment of 45 mHealth Apps for the Mental and/or Physical Health □ Workability
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 3: Improving productivity and workability • Domain 4 Healthy habits programs • Domain 5 Adaptation and compensatory mechanisms "Fifteen (33%) apps were targeted at physical risk prevention, 23 (51%) at psychosocial risk prevention (including stress prevention or coping with stress), and 34 (76%) at lifestyle promotion (prevention of sedentary behavior or promotion of physical activity). Twenty-three (51%) apps were directed at a minimum of two categories, and 22 (49%) at just 1." (de Korte et al. 2018

	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231882/#app1)
Need of training to use the solution	Mainly learning by doing Varied from one hour (for very basic apps) to four weeks (for extensive apps or apps that took time before the user received feedback)
Results and benefits	Results On average, the apps included 7 of the 26 BCTs (range 2-18). Techniques such as "provide feedback on performance," "provide information about behavior-health link," and "provide instruction" were used most frequently. Techniques that were used least were "relapse prevention," "prompt self-talk," "use follow-up prompts," and "provide information about others' approval." "Stress management," "prompt identification as a role model," and "agree on behavioral contract" were not used by any of the apps. The combination "provide information about behavior-health link" with "prompt intention formation" was found in 7/45 (16%) apps. The combination "provide information about behavior-health link" with "provide information on consequences," and "use follow-up prompts" was found in 2 (4%) apps. These combinations indicated potential effectiveness. The least potentially effective combination "provide feedback on performance" without "provide instruction" was found in 13 (29%) apps. Conclusions Apps for the occupational setting might be substantially improved to increase potential since results showed a limited presence of BCTs in general, limited use of potentially successful combinations of BCTs in apps, and use of potentially unsuccessful combinations of BCTs. Increasing knowledge on the effectiveness of BCTs in apps might be used to develop guidelines for app developers and selection criteria for companies and individuals. Also, this might contribute to decreasing the burden of work-related diseases. To achieve this, app developers, health behavior change professionals, experts on physical and mental health, and end-users should collaborate when developing apps for the working context." (de Korte et al. 2018; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231882/#app1)
Technical limitation or applicability limitations	Apps available for Android and/or Apple IOS Some of the Apps need Access Codes and are used for company programs
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Several apps assessed
Interoperability with other solution	□ Yes X No

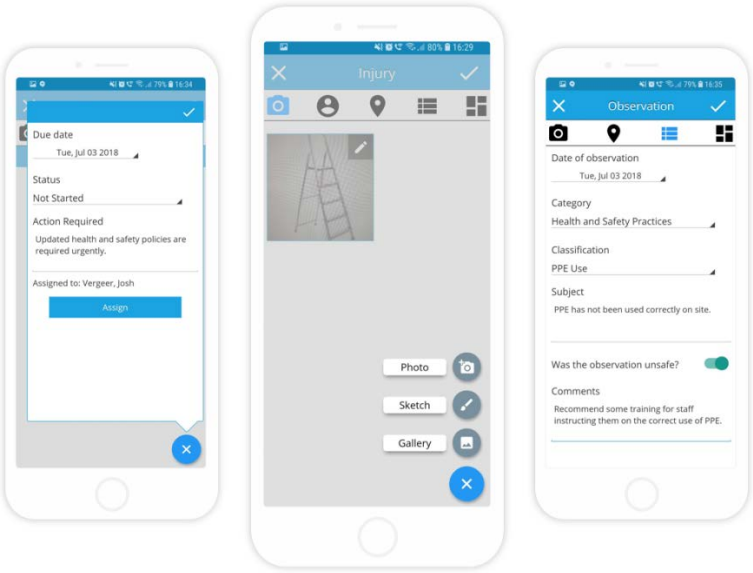
General information	□ Technology X Application
Name of the application or technology	Ladder Safety
Short description	"The National Institute for Occupational Safety and Health (NIOSH) is dedicated to ensure the safety of portable ladder users by developing and disseminating an easy-to-use interactive ladder safety application for smart phones. The NIOSH Ladder Safety application features a multimodal indicator, which uses visual, sound, and vibration signals to assist the user in positioning a ladder at an optimal angle. Furthermore, the application provides graphic-oriented interactive reference materials, safety guidelines and checklists for extension and step ladders selection, inspection, accessorizing, and use. The application is intended to help a wide range of ladder users, employers, and safety professionals, with their ladder-related safety needs. The ladder safety app is also 508 compliant." https://play.google.com/store/apps/details?id=gov.cdc.niosh.dsr.laddersafety&hl=en
Covered area/industrial sector	All areas/industrial sectors where ladders are being used
Manufacturer/ provider	Centers for Disease Control and Prevention (CDS) NIOSHLadderSafetyApp@cdc.gov https://www.cdc.gov/ The National Institute for Occupational Safety and Health (NIOSH) https://www.cdc.gov/niosh/index.htm
Market availability	Yes
Indicative cost	Free
Licence	Free
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions "The NIOSH Ladder Safety application features a multimodal indicator, which uses visual, sound, and vibration signals to assist the user in positioning a ladder at an optimal angle. Furthermore, the application provides graphic-oriented interactive reference materials, safety guidelines and checklists for extension and step ladders selection, inspection, accessorizing, and use. The application is intended to help a wide range of ladder users, employers, and safety professionals, with their ladder-related safety needs. The ladder safety app is also 508 compliant." □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) □ Workability

Domain/type of solution	Identified domain that cover the needs of different industry areas Domain 4 Healthy habits programs • The application is intended to help a wide range of ladder users, employers, and safety professionals, with their ladder-related safety needs.
Need of training to use the solution	No
Results and benefits	Safe ladder use
Technical limitation or applicability limitations	Requires Android 2.2 and up
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	This app has access to: control vibration No further information
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Vault Check
Short description	It is a health and safety app which provides the possibility to carry out inspections on mobile devices without the need of paper checklists.
Covered area/industrial sector	All professional sectors where health and safety inspections are required.
Manufacturer/provider	Vault Intelligence Limited Australia Melbourne office 145-147 Bouverie Street Carlton, Victoria 3053 Email:info@vaultintel.com Phone: 1300 723 240
Market availability	Yes Google Play Store https://play.google.com/store/apps/details?id=com.vaultgrc.QuantumInspect&hl=en_US Website of the manufacturer https://www.vaultintel.com/apps/check
Indicative cost	A demo version of the application can be downloaded for free. There is no information on cost for the associated software platform.
Licence	No license required for demo version.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability; Digital checklists for safety inspections reduce the risk of injuries and health damages.

	 https://www.vaultintel.com/apps/check (03.04.2019)
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Mitigate the risks of safety and health hazards
Need of training to use the solution	Short learning phase for understanding the functions and operation of the app. Easy to use for all skill levels, but inspections should be carried out under the supervision of experts of health and safety issues.
Results and benefits	Management of requirements for assets, workers and work processes. Reduction of safety and health risks, mitigation of risks of injuries and health problems. Digital checklists for efficient inspections, customised checklist templates for consistent inspections. Possibility to collect and store evidence through photographic and video functionality. Schedule activities by time frames for inspections or activities and assignment to other people.
Technical limitation or applicability limitations	Mobile Health & Safety Software for iPad, iPhone & Android
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Customised templates for safety inspections. Captured photos or videos. Tracked locations via GPS to stamp an inspection with a specific site location.
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application
Name of the application or technology	Vault Notify
Short description	It is a safety app which provides the possibility to capture information on a workplace event, incident or hazard from any location in real time.
Covered area/industrial sector	All professional sectors where safety hazards and incident risks occur.
Manufacturer/provider	Vault Intelligence Limited Australia Melbourne office 145-147 Bouverie Street Carlton, Victoria 3053 Email:info@vaultintel.com Phone: 1300 723 240
Market availability	Yes Google Play Store https://play.google.com/store/apps/details?id=com.vaultgrc.valert Website of the manufacturer https://www.vaultintel.com/apps/notify
Indicative cost	A demo version of the application can be downloaded for free. There is no information on cost for the associated software platform.
Licence	No license required for demo version.
Problem addressed (explain specifically how addressed the problem)	□ Learning, cognitive functions □ Sensory ability □ Physical ability □ Psychology/Mental abilities (including sleep problems) X Workability Capture and record of hazards, risks or incidents instant notification of workers

	 https://www.vaultintel.com/apps/notify (03.04.2019)
Domain/type of solution	Identified domain that cover the needs of different industry areas • Domain 2: Increasing job retention (postponing early retirement) • Mitigate the risks and impacts of safety hazards
Need of training to use the solution	Short learning phase for understanding the functions and operation of the app. Easy to use for all skill levels, but safety hazards and incidents should be under the supervision of health and safety managers.
Results and benefits	Reduction of impact of safety hazards or incidents. Capture of detailed information on injuries, illnesses and incidents in real time, including primary and secondary injuries. Capture of the information in real time so that hazards can be reduced quickly to prevent incidents from occurring. Empowering of the employees to identify hazards, record observations and contribute to a culture of safety. Accountability by giving workers access to the tools needed to keep themselves safe.
Technical limitation or applicability limitations	Mobile Health & Safety Software for iPad, iPhone & Android
In case of an application: which variables does it gathers and in which way can we retrieve them? (e.g. physical activity (steps, distance…) retrievable via an API)	Record of information about incidents: who, what, why and how. In addition: photos, timestamps and GPS location.
Interoperability with other solution	□ Yes X No

General information	□ Technology X Application (Samsung Health is an application)
Name of the application or technology	Samsung Health
Short description	In general, Samsung Health is an application and platform that supports the following: • Tracking various aspects of daily life contributing to wellbeing such as physical activity, diet, and sleep. • A dashboard which shows on one page a general overview of the most recent data saved. In addition, it provides direct access to each feature. Its composition and layout are customizable. • A set of features o Setting goals or using the goals suggested by the app to improve its results o Pedometer o Active Time measures the daily activity expressed in minutes; o Weekly summaries of the main features o Activity tracking taking into account market and sports sessions o Dietary monitoring (calories and nutrients absorbed) o Weight tracking o Floor tracking o Sleep monitoring o Ratings of the number of steps in different groups (all users, age group or friends) o Global challenges o Manually record an activity session (running, walking, hiking, biking). o Creating challenges on the number of steps o Measuring heart rate via dedicated hardware ▪ Supported S9 Edge and Note 8. ▪ On Samsung S10/Note 10 o only via Watch; o Measurement of temperature and humidity via dedicated hardware o Measurement Ultraviolet light via dedicated hardware o Monitoring of water consumption o Monitoring of caffeine consumption o Monitoring of blood sugar o Monitoring of blood pressure o Monitoring of oxygen saturation ▪ requires Samsung Health version 6.4.0.047 o Monitoring of Stress

	▪ Supported S9 Edge and Note 8. ▪ On Samsung S10/Note 10 • only via Watch; • Store personal data in a Samsung cloud-based central repository service that is transparent to clients. • To get your data stored in the Samsung Health, including Samsung watch app sync, requires to manage a set of personal data including User Information; • Access and manage users' "fitness history", to provide summaries, establish goals, send alerts, etc. The application is part of an ecosystem, created in cooperation with other actors that develop devices, sensors and fitness apps (e.g. Strava, MyFitnessPal, just to mention few). To connect with Samsung Health: • *Samsung Health Android SDK* - Sharing health data between Samsung Health and partner apps • *Apply for Partner App* – To enable data exchange between your app and Samsung Health • *SDK for Device* – users can find your devices using the Samsung Health's Accessories • *Apply for Partner Accessory* – To enable data sync from your health device to Samsung Health Samsung Health app provides users with a comprehensive view of their fitness, by applying the functions mentioned above. It also includes activity goals based on recommendations from the American Heart Association and the World Health Organization (i.e. move minutes and heart points). Samsung Health is intended to help users manage their overall health and wellbeing through capturing and tracking health related information and metrics and through providing access to articles and similar materials that may be of interest to users. All information provided is for general guidance only. Therefore, the app itself cannot be used for medical purpose.
Covered area/industrial sector	Samsung Health is agnostic with respect to the industry sector: it can be applied in any case where well-being, fitness management is important for workers.
Manufacturer/provider	Samsung Electronics Co., Ltd., Samsung Digital City, Samsung no 129, Maetan-dong, Yeongtong District, Suwon, South Korea
Market availability	Yes App:

	https://www.samsung.com/us/samsung-health/ https://play.google.com/store/apps/details?id=com.sec.android.app.shealth&hl=en_GB
Indicative cost	Samsung Health is free
Licence	The usage of the Samsung Health is regulated by specific terms and conditions: https://www.samsunghealth.com/privacy https://account.samsung.com/membership/etc/specialTC.do?fileName=shealth.html
Problem addressed (explain specifically how addressed the problem)	X Learning, cognitive functions • Forms of coaching are possible by using activity goals, activity recommendations, personalised plans or viewing and assessing activity history □ Sensory ability X Physical ability • Physical activity tracking • Physiological parameters tracking, depending on devices' available sensors (e.g. HR monitoring) X Psychology/Mental abilities (including sleep problems) • Sleep tracking is possible. □ Workability

Domain/type of solution	• Domain 2: Increasing job retention (postponing early retirement)
	  • Learning and training tools and technologies
	• Domain 3: Improving productivity and workability
	  • Physical activity programs tools
	• Domain 4 Healthy habits programs
	  • Nutrition
	  • Physical activity

Need of training to use the solution	No special training is needed to use Samsung Health apps, although reviewing information on its function (e.g. on heart points and move minutes recommendations by the American Heart Association and the World Health Organization) is to be recommended.
Results and benefits	Benefits are mainly in terms of adoption and maintenance of healthy habits, particularly in terms of physical activity.
Technical limitation or applicability limitations	Samsung Health is not endorsed as a medical application.
In case of an application: which variables does it gathers and in which way can we retrieve	Detected variables depend on smart phone and smart watch sensors and other Samsung Health compliant apps which are connected. A list of standard variables can be found here, including access raw data from sensors

them? (e.g. physical activity (steps, distance…) retrievable via an API)	• https://developer.samsung.com/health and provide an android studio to work with at • https://developer.android.com/studio/releases/platforms
Interoperability with other solution	X Yes (partially) □ No Interoperability is possible with other Samsung Health compatible apps and devices