WORKINGAGE

Smart Working Environments for All Ages

WANT TO KNOW MORE?

www.workingage.eu

https://www.linkedin.com/in/workingage-EU/

https://twitter.com/Workingage_EU

WORKINGAGE

WorkingAge tightly collaborates with a representative group of elder employees to study measures that help for them to improve their well-being in general, and specifically at work. Personalised guidance is a key part of this; all people are different! **WorkingAge** listens to users in order to get to know their diverse needs, and subsequently applies state-of-the-art deep learning technology for adapting the **WorkingAge** guidance to each personality.

In more than three years on the way in the **WorkingAge** project, after dozens of meetings and suffering difficult times, the consortium has grown into a tight team. The diverse expertise it integrates has enabled the creation of important knowledge. This knowledge has joined into a very powerful tool that can actually help the senior European workforce and the companies they work for, to shape their relationship of which both will benefit greatly.

WorkingAge has worked very hard and well on track to help society adapting to these current changes!

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INTRODUCTION

WORKINGAGE
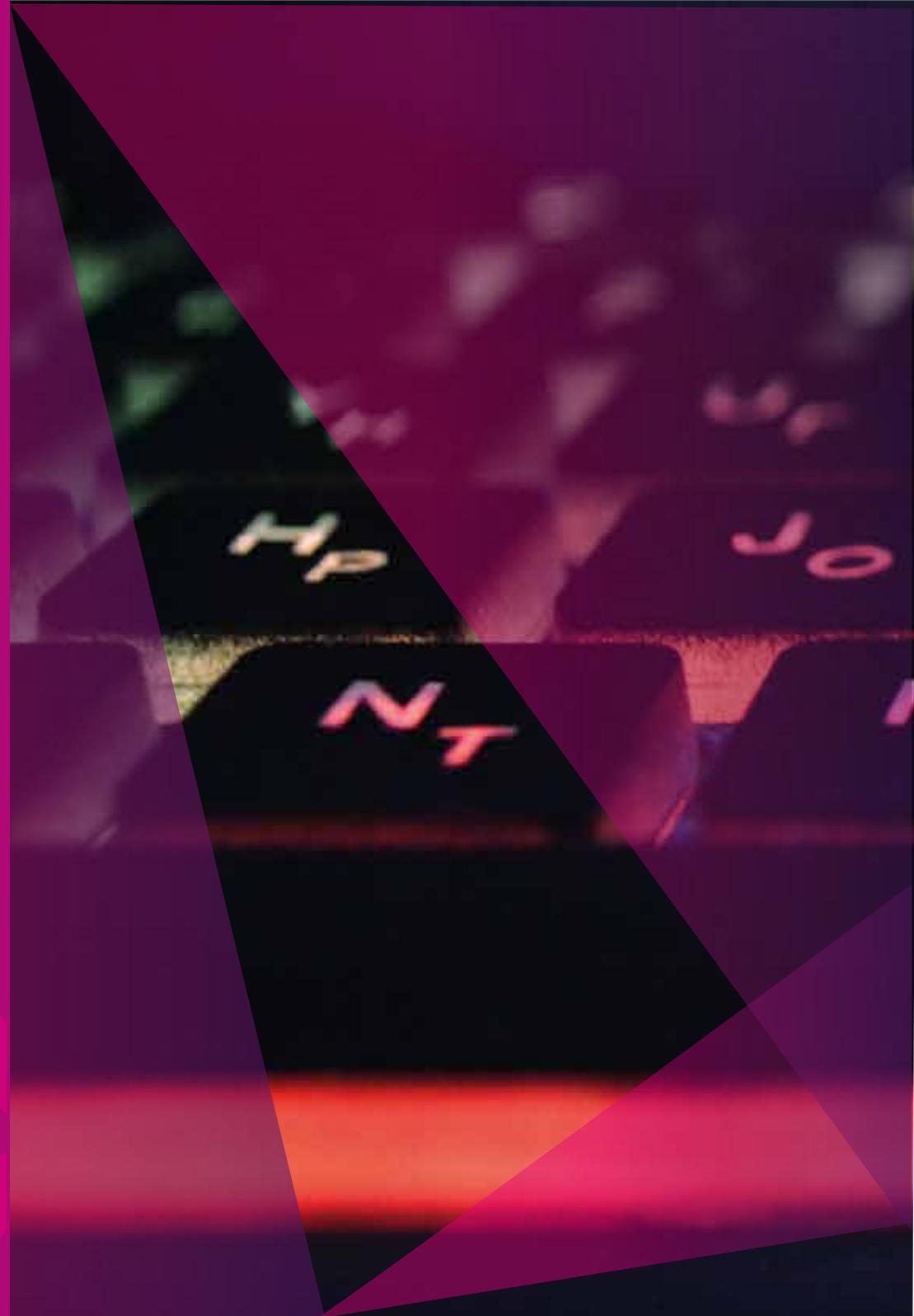
WHAT IS WORKINGAGE?

WORKINGAGE

WorkingAge seeks to improve the well-being of people over 45 years old, especially in the work environment for office, manufacturing and teleworking workplaces. It also considers the workers daily activities outside work.

With the changing demography and rising of the retirement age, the European workforce is aging. Older workers have specific conditions that need a specific response to remain healthy, resilient and maintain or improve their well-being, while feeling satisfaction in their daily lives and at work. At the same time, it can support motivation to stay working at higher age and enable better productivity.

The user will receive useful tips for a healthier life, the system will consider user's activities and give personalized advice. To do this, the worker will have a series of tools available: a mobile application for interaction with the system.

The application integrates a virtual agent who guides the user through questions and advice, many different factors concerning the users well-being are taken into account as ground for feedback to the user.

These factors are the psychosocial condition of the worker, the physical condition and working environment. All these data will be collected in the **WAOW Tool** where the user will be guided through advice, quick exercises and other recommendations.

This tool is customizable by the user, so that it can be adapted to personal preferences offering a rewarding experience. Of course, everything has been designed to guarantee full user privacy.

THE WAOW TOOL

THE WAOW TOOL

The **WorkingAge** team has developed the **WorkingAge Of Well-being (WAOW) tool. The WAOW Tool** aims at improving the health and well-being of people over 45 years old at work and leisure time by supervising their working conditions and providing different types of advice through personalized technologies and friendly & intelligent human interfaces. This tool is designed under a holistic framework that considers health, wellness, safety and sustainability.

WORKINGAGE TEAM

WORKINGAGE TEAM

1. ITCL CENTRO TECNOLÓGICO
2. EXUS
3. UNIVERSITY OF CAMBRIDGE
4. POLITECNICO MILANO 1863
5. Green communications
6. SAPIENZA BRAIN Signs
7. RWTH AACHEN UNIVERSITY
8. TELESPAZIO a LEONARDO and THALES company
9. audEERING Intelligent Audio Engineering
10. eena EUROPEAN EMERGENCY NUMBER ASSOCIATION
11. FUNDACIÓN INTRAS
12. TMA

The consortium is formed by the balanced collaboration of international level entities represented by:
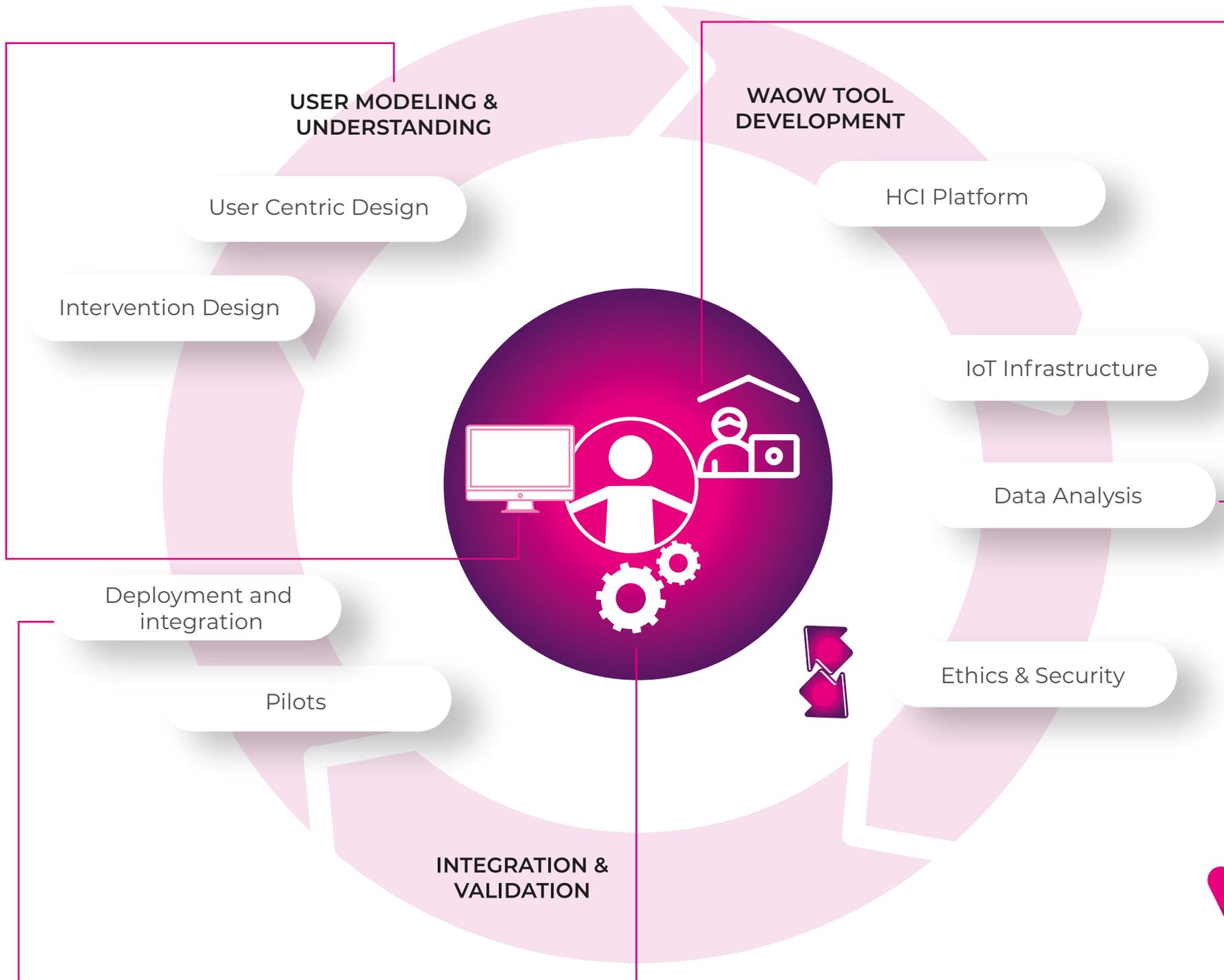
- 3 Universities (UCAM, POLIMI, RWTH)
- 4 SMEs (GC, BS, AUD, TMA)
- 1 RTD centre (ITCL)
- 2 Big enterprises and Industries (EXUS, TPZ)
- 2 Associations (EENA-112, INTRAS)

CONCEPT DIAGRAM

WORKINGAGE

USER MODELING & UNDERSTANDING

WAOW TOOL DEVELOPMENT

User Centric Design

HCI Platform

Intervention Design

IoT Infrastructure

Data Analysis

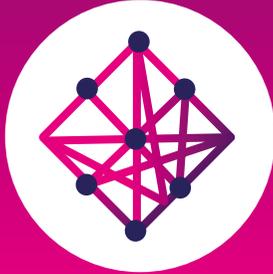Deployment and integration

Ethics & Security

Pilots

INTEGRATION & VALIDATION

WORKINGAGE

USER CENTRIC DESIGN

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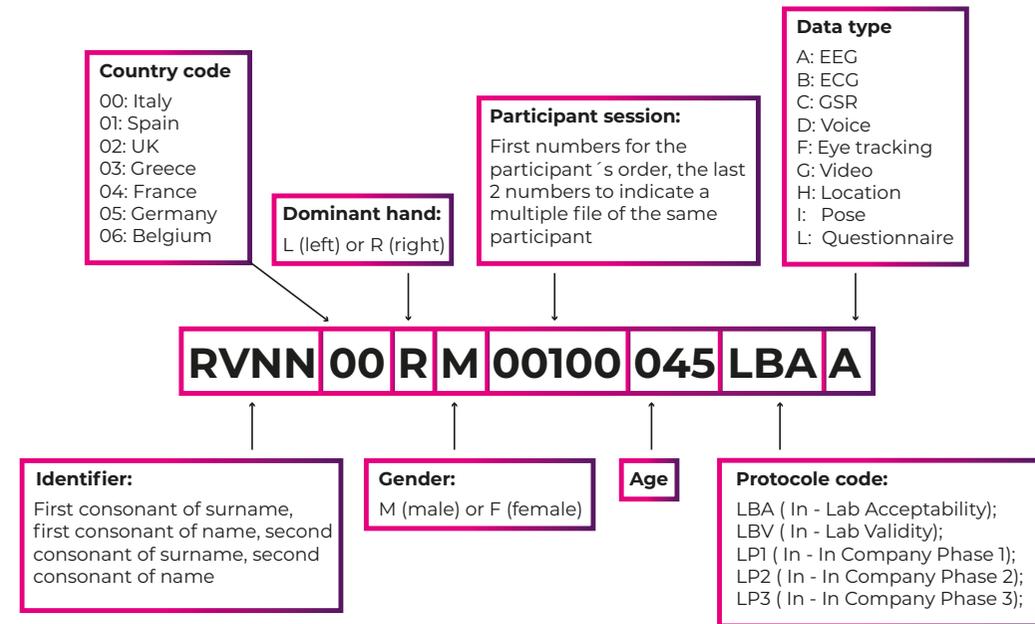
USER CENTRIC DESIGN

OBJECTIVES

As a basis for the following activities, the activity 2 dealt with the user-centered development of the **WAOW Tool**. Together with the technical and organizational requirements, this data was used for the development of the HCI Interface and Concept Design. Continuing, the activity defined the specifications on architecture, sensor technology, interaction, networking, local and global data streams and processing capacities in the context of cloud-based software, as well as the data management plan, which includes the basis for data collection and processing. Finally, the definition and planning of the pilot tests were carried out, thus the work package laid the foundation for further work in the project.

RESULTS AND ACHIEVEMENTS

- Definition of user and usage requirements following the user-centred development process, including a user study

- Development of the system concept

- Specification of technology selection criteria

- Data Management Plan

- Development of architecture

- Specification of pilot applications

Data Management Plan

Country code
00: Italy
01: Spain
02: UK
03: Greece
04: France
05: Germany
06: Belgium

Dominant hand:
L (left) or R (right)

Participant session:
First numbers for the participant´s order, the last 2 numbers to indicate a multiple file of the same participant

Data type
A: EEG
B: ECG
C: GSR
D: Voice
F: Eye tracking
G: Video
H: Location
I: Pose
L: Questionnaire

RVNN 00 R M 00100 045 LBA A

Identifier:
First consonant of surname, first consonant of name, second consonant of surname, second consonant of name

Gender:
M (male) or F (female)

Age

Protocole code:
LBA (In - Lab Acceptability);
LBV (In - Lab Validity);
LP1 (In - In Company Phase 1);
LP2 (In - In Company Phase 2);
LP3 (In - In Company Phase 3);

YES, this sensor is useful for my work [%]:

Noise, Light, Location, Humidty, Pollution

Touchscreen: 94%

Interface

- Smartphone
- Smartwatch
- Tablet-PC

User, Usage and Technical Requirements

INTERVENTION DESIGN

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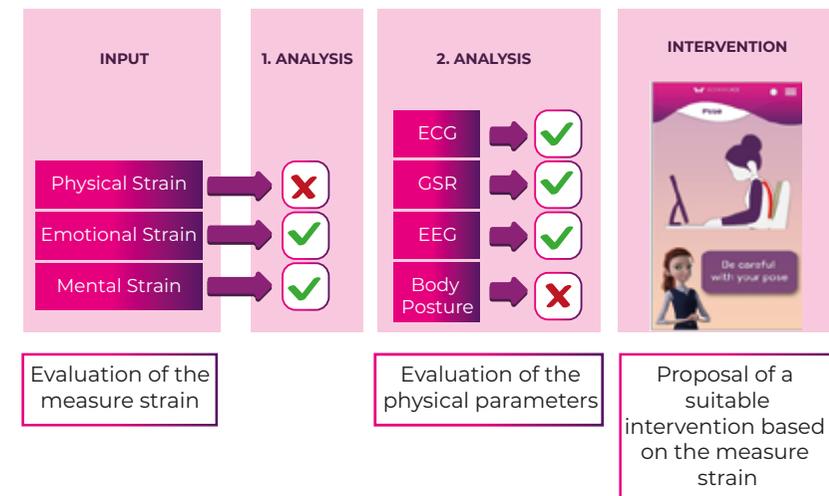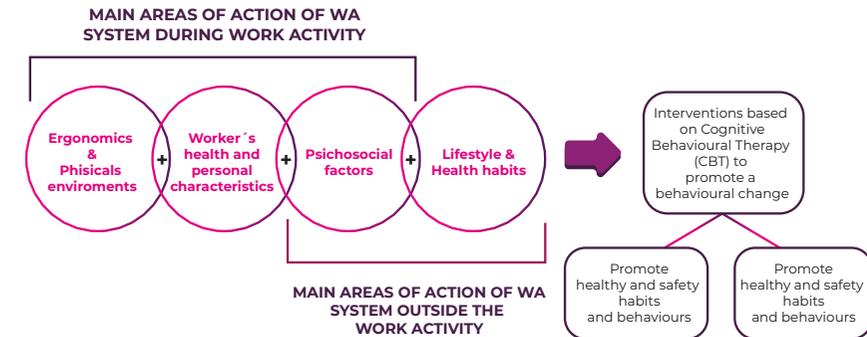# INTERVENTION DESIGN

OBJECTIVES

The objectives of this activity were twofold. First, design an intervention for the **WorkingAge system**, capable of identifying and evaluating health risk factors associated with or derived from the working conditions, without forgetting the effects that personal lifestyle have in the well-being state of the individual. Secondly, design an intervention plan according to risk profiles determined to promote healthy and safety habits both in and outside the workplace, in a personalized manner.

MAIN AREAS OF ACTION OF WA SYSTEM DURING WORK ACTIVITY

Ergonomics & Phisicals enviroments + Worker´s health and personal characteristics + Psichosocial factors + Lifestyle & Health habits → Interventions based on Cognitive Behavioural Therapy (CBT) to promote a behavioural change

Promote healthy and safety habits and behaviours

Promote healthy and safety habits and behaviours

MAIN AREAS OF ACTION OF WA SYSTEM OUTSIDE THE WORK ACTIVITY

RESULTS AND ACHIEVEMENTS

We elaborated health risk profiles for each of the three work cases, namely *Office, Teleworking and Manufacturing* and defined learning models to perform monitoring and data analysis, through the use of a number of sensors and technological devices implemented in the workplace.

The result was an Intervention Model based on three pillars: i. framework for stress and strain assessment and intervention; ii. SMART GOALS and Intervention Model for user behavioural change and assessment; and iii. the Recommendatory System which interventions proposed are defined according to evidence-based criteria.

The intervention methodology designed to be launched through the **WAOW** ("WorkingAge of Wellbeing") **Tool** was focused on a holistic and comprehensive approach considering ergonomic conditions and physical environment, workers' health, psychosocial factors, lifestyle and health habits. The final goal is to help to reduce strain in different working conditions, while also promoting healthy and safety habits, both in and outside the workplace.

INPUT	1. ANALYSIS	2. ANALYSIS	INTERVENTION
Physical Strain	❌	ECG ✅	
Emotional Strain	✅	GSR ✅	
Mental Strain	✅	EEG ✅	
		Body Posture ❌	

Evaluation of the measure strain

Evaluation of the physical parameters

Proposal of a suitable intervention based on the measure strain

HCI PLATFORM

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HCI PLATFORM

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OBJECTIVES:

To research and develop the Human-Computer Interface aspect of the **WAOW Tool**

1

Creating the user interface for interaction and visualisations for the mobile app

2

Enabling gesture-based interaction for the user

3

Analysing the environmental noise and sounds

4

Analysing the speech and the nonverbal vocal cues of the user in terms of what they say and which emotions they express

5

Analysing the face and eye-related cues of the user to recognise their affective and cognitive states

6

Neurometric evaluation of the user's nonverbal behaviour

7

Detecting the location of the user

8

Integrating all of these subsystems as a distributed and connected WA network

HCI PLATFORM

RESULTS AND ACHIEVEMENTS

Main outcome: A novel multimodal framework for assessing human cognitive and affective states in work settings.

Detailed outcomes:

- A visually appealing and user-friendly interface with insightful visualisations for user-**WAOW Tool** interaction
- Accurate body pose recognition module that analyses user joints and pose
- Accurate hand gesture recognition module that enables intuitive gesture-based interaction for the user
- A novel custom-made NoiseBox that monitors the environmental noise and can trigger notifications for adjusting the noise to optimum levels, and enables voice activity detection and transmission
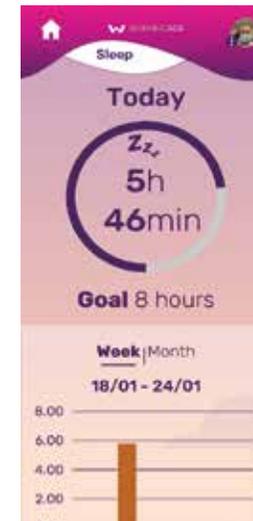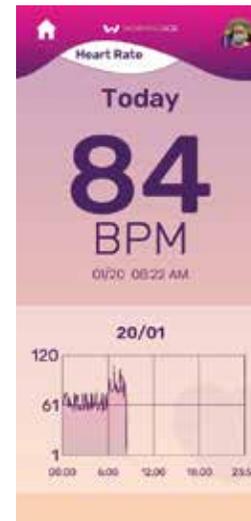
HCI PLATFORM

- Novel deep learning-based audio module that analyses the speech and the nonverbal vocal cues of the user in terms of what they say and which emotions they express
- Novel deep learning-based facial affect prediction that analyses the facial gestures and expressions to predict user affect
- A module that analyses eye gaze and predicts user mental workload and strain level
- A neurometric component that evaluates user's physiological signals to predicts user mental workload, stress level and affective state
- An accurate user location detector
- A novel multi-site data collection protocol for acquiring multi-modal human behavioural data (audio-visual and physiological signals) under various simulated working conditions
- A novel multimodal dataset of human behaviours in work-like context

IOT

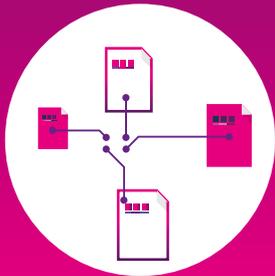Smart Working Environments for All Ages

IOT

OBJECTIVES

The objectives of the activity 5 were to design the architecture and define the specifications of the **WAOW Tool** with regards to the constraints and requirements expressed by users, and to develop the **WAOW Tool** IoT infrastructure, sensors and functionalities. The challenge was to create a solution that can easily integrate the company's IT environment and that ensures worker's data security, privacy and sovereignty. Thus, in both fixed and mobile environment.

RESULTS AND ACHIEVEMENTS

We achieved to design a dedicated edge-based solution in which IoT devices and their intelligence are relocated on company's premises. Thus, we can monitor people's health and working environment without the need for any third party's cloud and with all data being collected, processed and stored locally. The infrastructure we created is autonomous. Servers, devices and platforms can be deployed on premise without interfering with the company's IT infrastructure. The Internet of Edges (Horizon Results ID: 31065) enables secure interconnection and synchronization of multiple edges for providing the **WAOW Tool** services to companies operating at multiple locations and to teleworkers.

WAOW Tool Architecture
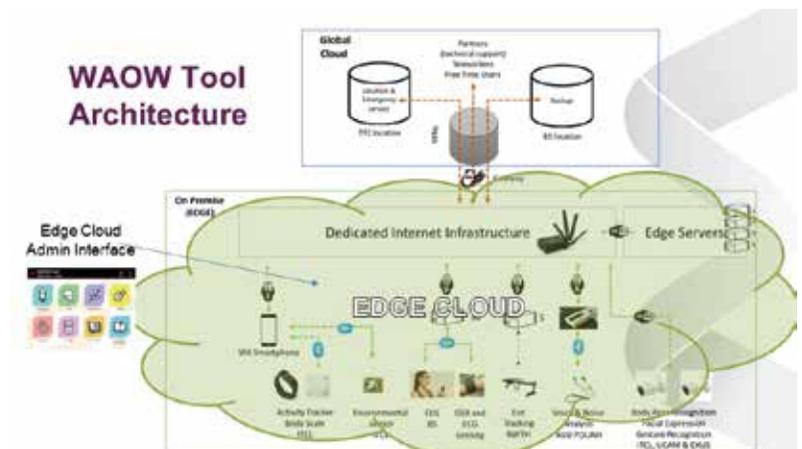
DATA ANALYSIS

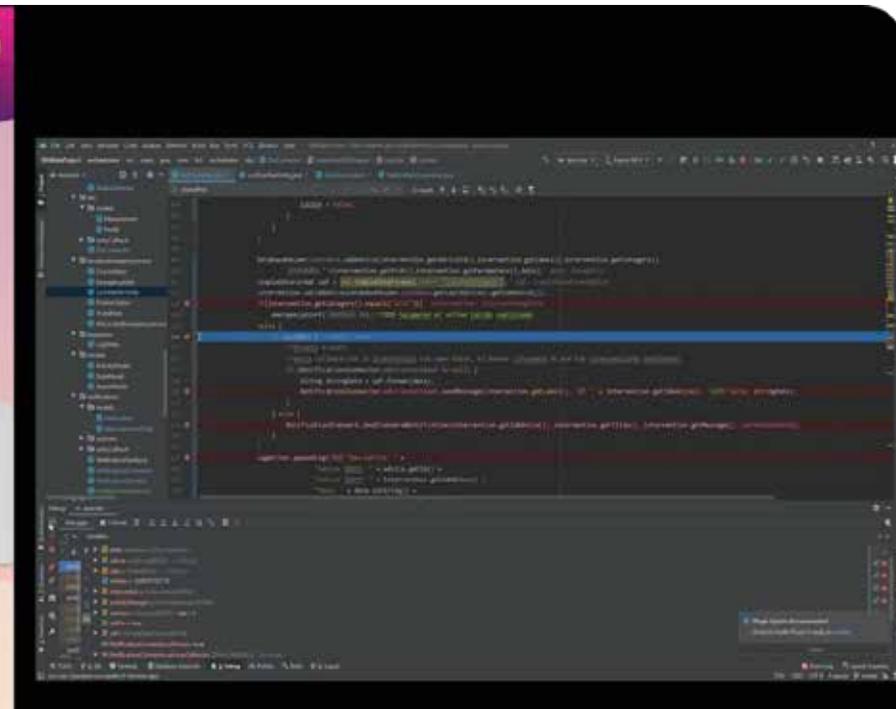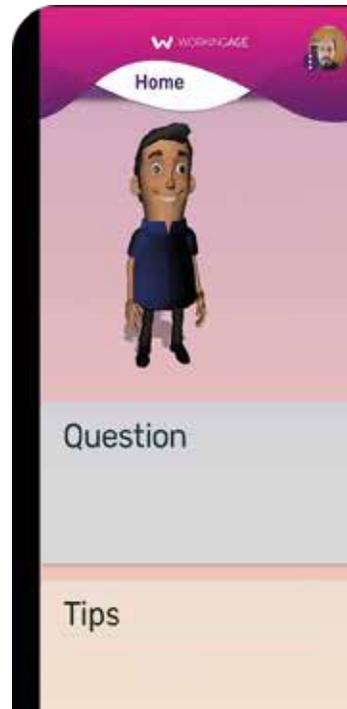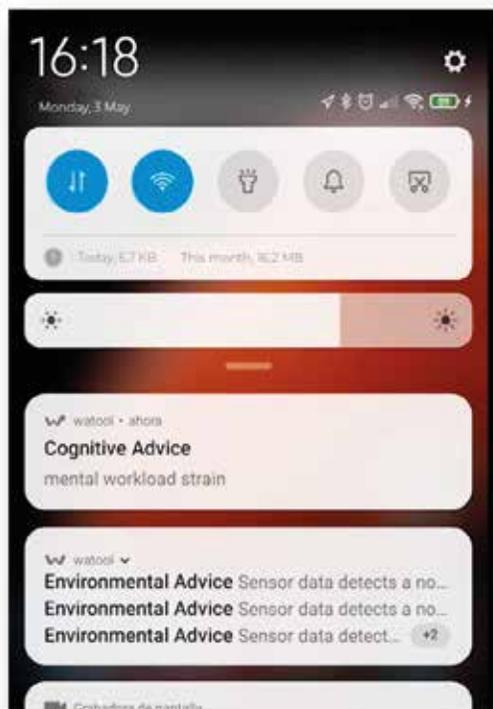Smart Working Environments for All Ages

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DATA ANALYSIS

OBJECTIVE:

To research and develop the Decision Support System (DSS) of the WAOW Tool, its reasoning core.

RESULTS AND ACHIEVEMENTS

Main outcome:

A reasoning and adaptive engine that can interact with the workers according to their cognitive and affective states in a real-working environment.

DATA ANALYSIS

Detailed outcomes:

- A visually appealing and user-friendly interface with insightful visualisations for user-**WAOW Tool** interaction.

- The DSS was developed through an Expert-Driven approach: based on knowledgeable expert directives/experience.

- The technical implementation of the DSS allows the complete control of content and behaviour.

- The Ontology model allows an accurate description of the workers' cognitive and emotional state.

- Besides that, the Ontology provide a common and technical terminology to describe the workers' activities and tasks.

- The DSS provides per-workers suggestions and advices according to their cognitive and emotional state. This can be more efficient than a behavioural approach, since the workers are not required to directly provide information abut their state to the **WAOW Tool**.

- The DSS behaviour and knowledge is adapting according to the workers' profile, their interaction history with the respect to the **WAOW Tool.** In this way, the DSS can evolve and fit to each specific worker profile.
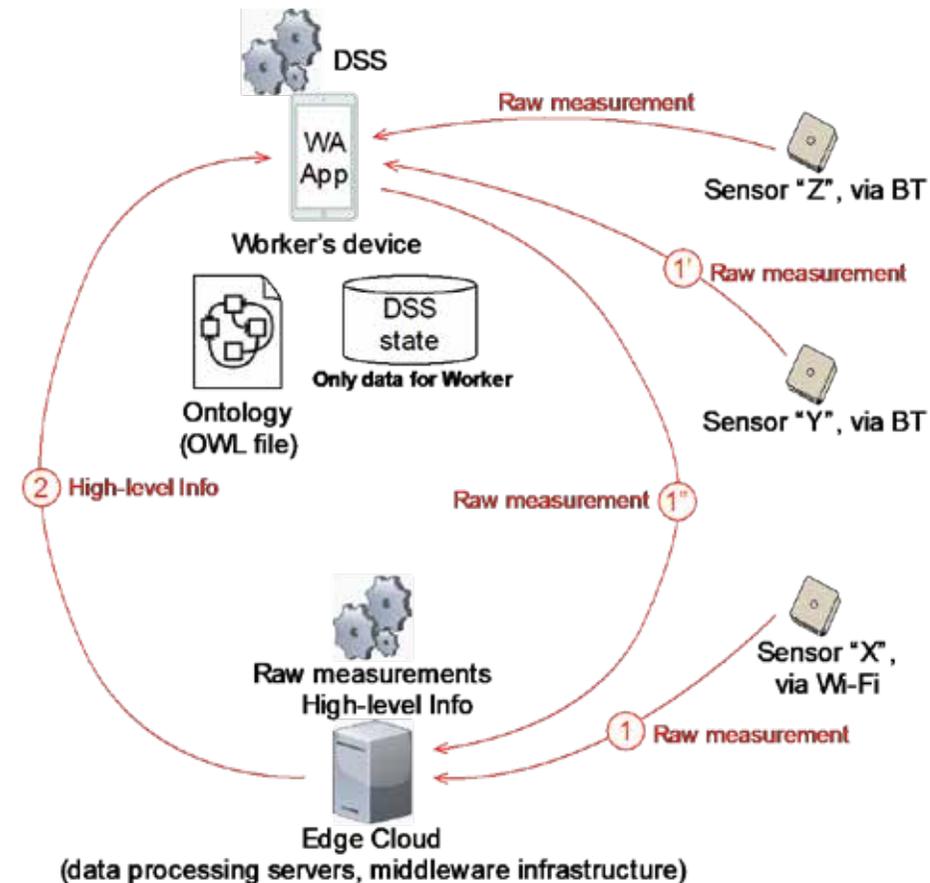
ETHICS AND SECURITY

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ETHICS AND SECURITY

OBJECTIVES

The activities focused on the analyses of ethical and legal aspects of the project as well as of the aspects related to secure and privacy-preserving data management in a context with multiple data sources, collectors and processors.

WorkingAge processes a significant amount of sensitive data, known as special personal data in the lexicon of the EU General Data Processing Regulation (GDPR), 2016/679, calling for procedures which fully respect the fundamental rights on personal data stated in the regulation itself.

To this end, the objectives of activity 7 were to provide advices and recommendations to design the **WAOW Tool** and its corresponding IT infrastructure, so that its interaction with the user respects both him/her and his/her rights in terms of ownership and control over personal data.

Further goals concerned the drafting of all legal documents to be compliant to both the GDPR and the national ethical requirements of the countries where the developed tools are validated, ensuring that any user willing to participate in data collection was clearly informed on the procedure, and provided an overt, informed consent.

ETHICS AND SECURITY

RESULTS AND ACHIEVEMENTS

WorkingAge project built on user's data collection and feedbacks on the workplace, through sensors, questionnaires and direct interviews. This allowed the **WAOW Tool** to be built on user-respecting interactions tailored on the specific characteristics of the user.

The research efforts conducted during the activity 7 produced a design of an IT infrastructure abiding the privacy tenants of the minimality of data collection and cryptographically enforced access control, without compromising the possibility to provide a workplace wellness-enhancing tool through personal data analytics.

Data coming from a specific sensor was collected and processed only by the project's partner entitled to access it, with a legal document which defines clearly the data sharing rights within the consortium, while the identity of the user's is preserved via a randomly chosen pseudonym bound to **WAOW application** installed on the smartphone of the user.

The designed infrastructure allowed to leave the users in control of the only device where the aggregation of data coming from different sensors was performed, i.e., their smartphone, preventing possible re-identification vulnerabilities, and in turn raising the overall confidence in the system.

Activity 7 monitored and collected the documents related to the needed national ethical approvals abiding to the Spanish and Greek regulations to finalize the project.

Finally, from a legal standpoint Activity 7, provided the Information Sheet and Informed Consent Form for the user's of the **WAOW Tool**, the Data Sharing Agreement among the WorkingAge partners to discipline the sharing of user's data within the consortium, as well as the formal agreements between the consortium and each entity that offered to allow their employees to participate voluntarily to the in-field validation of the **WAOW Tool** In-company Test Agreement.

DEPLOYMENT AND INTEGRATION

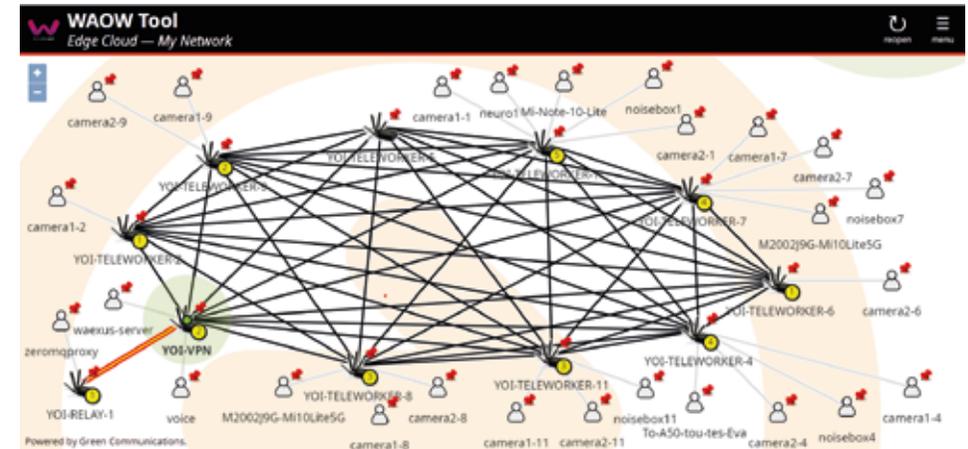Smart Working Environments for All Ages

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DEPLOYMENT AND INTEGRATION

OBJECTIVES

The objective of the activity 8 is to implement the architecture for the WorkingAge system and undertake the assembly and integration of the different components into the complete system prototype. The solution consists of local components (e.g., wearables & other sensors, mobile device), distributed components (relying on edge-servers for processing), and the enabling communications infrastructure (both hardware and software communications). This activity also undertakes the initial testing of both individual components and the system prototype, before its deployment to the pilot studies.

RESULTS AND ACHIEVEMENTS

The successful deployment of the prototype solution where all sensors and components were tested and validated in laboratory conditions. The end-to-end testing of the WorkingAge prototype solutions with a custom communication protocol that complies with user privacy and security concerns and other GDPR requirements. The evaluation and implementation of lessons learned for improvement of the WorkingAge solution. Technical guidance for the deployment in the three pilot cases.

PILOTS

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PILOTS

OBJECTIVES

Evaluate the **WAOW Tool** system's effectiveness and acceptance in real-world conditions:

Workplace Environments

- Office work
- Manufacturing
- Teleworking

Non-Workplace Environments

- Out of work
- At home

RESULTS AND ACHIEVEMENTS

Activity 9 is where all the previous work done in advance by the partners in the different activities become real and the volunteers enjoy and benefit from the use of the **WAOW Tool**.

The pilots are divided into:

SHORT-TERM TESTS: During this period the volunteers started to use the **WAOW Tool**, and the technical partners tested the different sensors in order to achieve a user-friendly WAOW Tool validated and reliable **WorkingAge system**.

DESIGN

PARTICIPANTS:	Ofiice Work	Teleworking	Manufacturing
TESTING PERIOD: 1 month	16	9	13

TESTING METHODOLOGY:

SINGLE DAY TEST: Each user will interact with different components (sensors and the User Interface) of the WAOW tool, one at time, during several one day sessions.

WEEK TEST: Each user will interact with different components (sensors and the User Interface) of the WAOW tool, one at time, during several one day sessions.

LONG-TERM TESTS: Throughout this period the volunteers are using the **WAOW Tool**, whose objective is to obtain the levels of adherence, compliance, effectiveness and sustainability of the **WAOW Tool**.

DESIGN

PARTICIPANTS:	Ofiice Work	Teleworking	Manufacturing
TESTING PERIOD: 1 month	16	9	13

TESTING METHODOLOGY:

PRE Interv. Assessment

POST Interv. Assessment
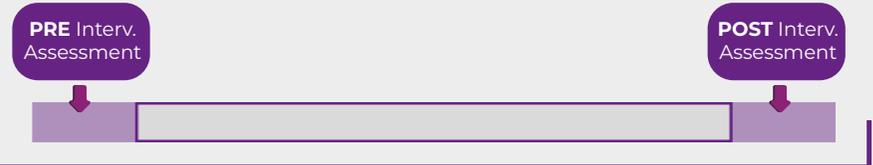
Continuous testing by means of questionnaires an WA system data -set

PILOTS

USE CASES

The **WorkingAge** project pilots are developed within different **USE CASES**, which are:

OFFICE CASE: at **MUTUA Universal in Barcelona (Spain).**
In this use case, the working environment is homogeneous and ergonomically controlled. 16 volunteers were recruited for the office use case.

MANUFACTURING CASE: Hosted at **Grupo Antolín RyA in Valladolid (Spain).**
The factory manufactures car interior components such as dashboards, doors, etc. 13 volunteers are using the system in this use case.

TELEWORKING CASE: at project partner **EXUS in Greece**.
In this use case the working environment is heterogeneous and ergonomically less controlled. 9 teleworkers volunteered to participate in the pilots.

COLLABORATING COMPANIES

WORKINGAGE

MUTUA UNIVERSAL

The purpose of action and competences of **Mutua Universal** includes, among other preventive activities, research, development and innovation activities, aimed at reducing accidents and improving prevention, occupational risks, safety and health of the recipients of our services.

The promotion of healthy habits in the work environment and the consideration of the characteristics of vulnerable groups, together with the commitment to innovation and the use of technological advances, are decisive to improve working conditions, as well as the health and well-being of people, their quality of life and especially active aging.

Mutua Universal employees participate in the WorkingAge project on a voluntary basis, d**emonstrating their commitment to innovation and health promotion.** During the tests, participants use the **WAOW Tool**. The tool provides information on various parameters, such as body posture, recommendations for improving them, and tips for maintaining a healthier lifestyle, in the work environment and beyond.
The final objective of the tests is to help the participants to improve their health habits, as well as to enrich the **WAOW Tool** with the contributions made by the users.

Mutua Universal

GRUPO ANTOLÍN RYA

Grupo Antolín is one of the leading interior manufacturers worldwide with over 150 plants in 26 countries. Grupo Antolín has achieved this strong industry presence through over seventy years of working with their customers in order to develop a complete cycle of component manufacturing, from their conception and design, through the development and validation stages, to their industrialisation and sequenced delivery.

Grupo Antolín is working hard on spearheading the transformation that the automotive industry is currently experiencing with regard to vehicle interiors by collaborating with their customers. Grupo Antolín does so in order to develop more sustainable and technologically advanced vehicles that are also adapted to the new needs and requirements of their passengers.

Grupo Antolín RyA Valladolid collaborates with the WorkingAge project, promoting best practices in occupational risk prevention, highlighting its focus on innovation in this area and prioritizing the workers' health, with the ultimate goal of mitigating the effects of aging, stress and strain, to improve their wellness.

As the result of the collaboration between Grupo Antolín RyA Valladolid with the **WorkingAge** project, its production workers will be able to benefit from the **WAOW Tool** during their working day. This tool will provide relevant tips for the workers, such as promoting awareness on their posture when carrying out different tasks for improving it, and in their free time, being able to receive active recommendations for improving their sleep patterns, and advice for different aspects on healthy living.

EXUS

EXUS is an enterprise software company specializing in credit risk management, digital transformation services and innovation management. **EXUS** was founded with the vision to simplify enterprise software, make it simple, accessible and exciting. **EXUS** supports organisations worldwide to improve their results by introducing simplicity & intelligence in their business processes through state of the art technology. **EXUS** designs, creates and markets software solutions and services in several business areas such as finance, e-health, e-learning, and security. **EXUS** covers a wide spread of activities by leveraging the expertise of its 130+ people strong technical divisions that are led by expert project managers and senior consultants.

Due to the COVID-19 pandemic, **EXUS** has transitioned to a remote working environment. Despite the challenges of teleworking, the promotion of healthy habits among its workforce, particularly to workers over the age of 50, remains a priority. The **WorkingAge of Wellbeing Tool (WAOW Tool)** affords precisely such an opportunity. Through the pilot use of the developed technology in the **WorkingAge** project, our employees can benefit from a digital personal assistant that can lead to healthy aging both inside and outside of the working environment.

EXUS.

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