Ageing@Work

Smart, Personalized and Adaptive ICT Solutions for Active,

Healthy and Productive Ageing with enhanced Workability

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Requirements and use cases

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Executive Summary

The overall aim of this deliverable is to reformulate the basis of the user-centred approach that will be followed throughout the project, providing updates and refinements on user requirements and use cases. In this second version of the D 2.1, we have focused on the detailed analysis of the users' needs and specifications, alongside with the industry requirements, and the use cases, in order to establish the user requirements for the smart, personalized and adaptive ICT solutions for active, healthy and productive ageing with enhanced workability of the Ageing@Work project.

Keeping this objective in mind, a new study has been carried out on the needs of the mining and industry workers who formulate the project's targeted end user groups, and on the problems or difficulties that arise to them to adapt to their jobs as they get older. Notably, compared to the first version of the deliverable (D2.1) these issues are also adapted to the profound changes that have occurred in both sectors derived from the SARS COVID-19 pandemic.

To achieve this goal, we have started from the first version of the D 2.1, which was elaborated by applying our knowledge and professional experience on both sectors, both in the interior, manufacturing industry and the extractive industry in open-pit operations, employing a work methodology based on the following elements: literature view, questionnaires, surveys, personal interviews, and focus groups, and we have adapted its contents to the constantly changing circumstances, the need to prevent contagions, and to ensure the safety of the workers.

Also, the deliverable D2.1 was subjected to the Commission´s review, from which the recommendation to reduce the number of proposed use cases and focus the studies on a single pilot, was received. Therefore, without altering its essence, the use cases have been redesigned as will be explained in the following sections.

These comments have been taken into account, and new online surveys have been proposed, modifying their design and content, seeking a greater and more representative participation of men and women and the stakeholders´ involvement, specifically investigating the level of user acceptance in privacy matters and the way in which the application will make recommendations. Through these online surveys, as will be seen in the corresponding section, it has been possible to reach a high percentage of women who represent almost 50% of those surveyed. In addition, it has been possible to access diverse professional profiles beyond potential users, such as farm managers, lawyers, engineers, health and safety managers, etc., managing to reach interest groups whose positioning towards the project had been analysed indirectly in the previous deliverable.

In order not to reiterate content already developed in the previous D 2.1, this deliverable will consider the reports on the general situation of aggregate sites and factories, the main risks, the work and safety equipment, the used machinery and a preliminary identification of our `personas´, as examples of ageing workers established through our previous knowledge and conversations with them, already reproduced.

Although, a brief description of the current safety measures in mines and factories and the way in which the working conditions have been altered with respect to the previously exposed scenarios will be provided.

A series of Annexes is provided at the end of the deliverable, which include the protocol with the security measures approved in quarries and gravel pits due to COVID-19, (ANNEX I), as well as a summary table with the results of previous surveys regarding user requirements definition and prioritization (ANNEX II), and finally, an ANNEX III that includes direct links to the surveys carried out with the workers through `Google Forms´.

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List of Terms and definitions

Abbreviation	Definition
AI	Artificial Intelligence
ANEFA	Asociación Nacional de Empresarios Fabricantes de Áridos (National Association of Aggregates Manufacturers)
AR	Augmented Reality
DR	Design Requirement
FR	Functional Requirement
IR	Interaction Requirement
R&D	Research & Development
RQ	Research Question
SAG	Siemens
SW	Software
UC	Use Case
UsReq	User Requirement
VR	Virtual Reality
WS	Workshop

1. Introduction

The user requirements, and the use cases proposed in the deliverable D 2.1 summitted in September 2019, considered the user's requirements in a context of working conditions that have experienced substantial changes as a result of the pandemic of COVID-19.

In addition, the user requirements, and the use cases proposed in the deliverable D 2.1, were reviewed by the European Commission, which made a series of recommendations, to improve their adaptation to the projected objectives.

These issues have been considered when preparing this deliverable, which, based on the same scenarios, people, machinery and jobs already analysed in D 2.1, has had to be adapted, introducing changes especially in terms of methodology and of proposing use cases.

The `smart, personalized and adaptive ICT solutions for active, healthy and productive ageing with enhanced workability´ - Ageing@Work project, focuses on the need to adapt the working conditions of the workers older than 45 years old, to the new needs that arise from their ageing and therefore will research, and develop a platform of ICT tools, which, on one hand, will help tailoring the workplace to the evolving needs and specificities of the ageing workers, both in terms of ergonomics and in terms of work processes and task assignments and on the other, will support the ageing workers´ active and healthy ageing at work and at home. To support workability, the platform will include physical and mental health support ICT tools, as well as telepresence and productivity enhancement tools, based on advanced AI, AR, VR, and telepresence, lifelong learning and knowledge sharing, with particular emphasis on flexible work management, along with quality-of-life support.

The integrated system will be developed in accordance with a user-centred design process and evaluated in the two pilot sites with regard to core Industry 4.0 processes of mining and machines production.

1.1. Scope of the deliverable

The purpose of the present deliverable is to re-evaluate the needs of the targeted users alongside with the industry requirements, as well as the project use cases derived from the conducted analysis.

In this line, this deliverable reports the results of the user requirement collection and analysis performed with the aim to identify the requirements and expectations of the A@W target user group (open pit miners and industry workers) and on this basis, define the expected use cases in the context of everyday activities of this user group. Finally, a prioritization of use cases was performed based on the results of the surveys and the Commission 'recommendations.

1.2. Relation to other deliverables

This deliverable is the second version of the D 2.1 summitted on month 9.

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This second version will be delivered in June (M30), so it reflects the changes experienced by both sectors in a 21-month period.

Considering the enormous social, political, economic and health changes, this new version will be decisive to other deliverables that are due on the same month such as Deliverable 7.2 Pilot trials definition and planning.

In addition, as the basis of the entire project, its content will be essential for the development and completion of the other WPs.

In the following table, a list of Work Packages and its Work Package Leader is provided:

	WP Name	WP Leader
WP1	Ethics requirements	CERTH
WP2	User requirements, system specification and architecture	ASER
WP3	Worker and workplace models and orchestration support tools	UPAT
WP4	Unobtrusive ambient activity and behavior tracking	KUL
WP5	The Ageing@Work Virtual Coach	CERTH
WP6	Personalized age-friendly productivity enhancement tools	UPAT
WP7	Ageing@Work platform integration and validation	UPM
WP8	Communication, Dissemination, Exploitation and Business Planning	Q-PLAN
WP9	Project Coordination and Management	CERTH

Table 1: List of WP and WP leader

The following figure shows the relationships between work packages.
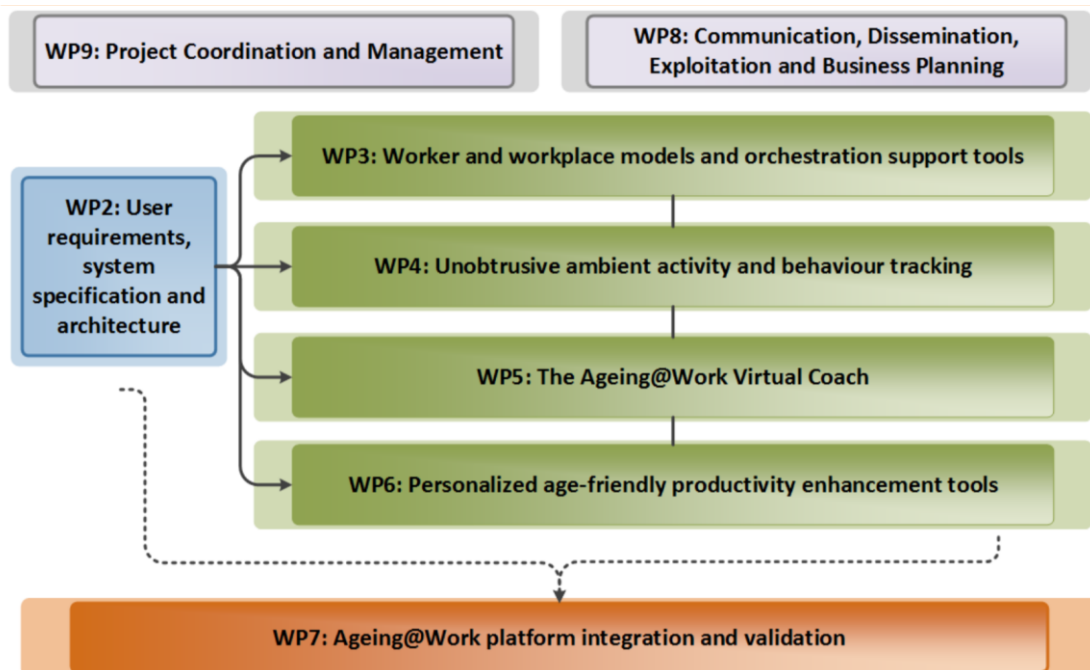
Figure 1: List of related WPS.

The identified Use Cases in WP2 will form the basis for preparing the application and evaluation scenarios so the main findings will also feed the work involved in the creation of the business cases and scenarios and will be disseminated to different stakeholder groups.

1.3. Deliverable structure

Chapter 2, `Pilot changes´, it provides a general overview of the changes in workers and workplace organization, new security measures, access limitations and changes in user daily life experienced as a result of the pandemic situation.

In chapter 3, `Methodology´, describes the methodology that was followed when preparing the preliminary use cases, surveys, and workshops and analysing the data obtained in order to redesign and simplify the proposed use cases.

In chapter 4, `Use Cases´ the updated project use cases are presented, considering the objectives of the project, the updated user requirements as have been further elaborated in the present deliverable, and the context in which such solutions or tools have to be applied.

A series of **Annexes** is provided at the end of the deliverable, showing the official security protocols to deal with the COVID-19 virus, in quarries and gravel pits (ANNEX I); a summary table with the results of prioritization of user requirements and use cases obtained in the original use cases (ANNEX II); and direct links to the surveys made to users through the `Google Forms´ application (ANNEX III).

2. Pilot changes

The purpose of this chapter is to provide with a general idea of the changes in the working conditions both in the extractive industry as well as in the factories, as caused by the SARS-COVID-19 pandemic.

Both in Germany and in Spain, the impact of the virus has led to the establishment of restrictive measures that have particularly affected the freedom of movement of people, which has had repercussions on the organization of work centres, and the measures of security that have been imposed to safeguard the health of the workers.

2.1. Life in the quarry post COVID-19

General scenario in Spain:

The COVID-19 pandemic has been especially hard in countries like Spain, where the death toll reaches almost 100.000, with almost 4 million infected (Figures posted since March 17, 2020, Source INE (National Spanish Statistical Institute). This means that almost 10% of the Spanish population has been affected.

Until May 9, 2021, Spain was in an `alarm State´, which supposed limitations on the free movement of people throughout the national territory, perimeter closures of regions, curfews and other measures, in order to avoid the spread of the virus.

As of May 9, 2021, the power to decide which security measures to implement passes to the Autonomous Communities, depending on the incidence of the virus in each region.

From the accumulated experience on the behaviour of the virus in the past summer period, it is expected that the level of infections will decrease as temperatures rise. This, together with the advancement of the vaccination process, at the end of the summer it is expected that at least 70% of the Spanish population will have received at least one dose of the vaccine, making the prospects regarding the fight against this pandemic optimistic.

However, the emergence of new variants of the virus, the possibility of rallies when autumn arrives, leads to conclude that the end of the pandemic may not yet be close in time.

The Spanish and European authorities continue to recommend prudence to the population, to avoid spikes that could harm these good prospects.

Changes in the organization of work in aggregate sites:

Throughout the pandemic, sanitary measures have been implemented to avoid contagion among employees as much as possible.

Although the characteristics of the work carried out in aggregate farms mean that the worker's tasks are carried out in a practically isolated manner, measures have had to be implemented especially in terms of entry and exit times in quarries and troughs, use and cleaning of common areas and machinery, safety equipment and access limitations for people outside the farm.

The official security protocol against COVID-19 in quarries and gravel sites will be exposed in ANNEX I.

2.2. Life in the factory/office post-COVID-19

General scenario in Germany:

The Covid 19 pandemic has also left clear traces in Germany. A total of 3,727,333 confirmed infections and about 90,000 related cases of death have been reported since February 2020 (RKI, 2021).

In March 2020, numerous restrictions were imposed on public life, which were gradually lifted last summer. In autumn, however, the situation aggravated again, and severe limitations were imposed once more. In December 2020 the government even decided on a second lockdown. Later on, in April 2021, the Fourth Civil Protection Act was passed to take control of the situation by imposing uniform federal measures. Previously, measures could vary among the individual states and counties. The so-called, federal emergency brake" The so-called federal emergency brake envisions a phased plan of easing or tightening measures depending on the incidence of a county. Decisive incidence values are 100, 50 and 35. Since the current nationwide 7-day incidence is only 5.4 (as of 29.06.2021, RKI), measures in public life have been lowered in many places.

The decisive factor for this positive development, apart from the rising temperatures, is in particular the increasing vaccination rate. Currently, more than 29,403,000 people have been vaccinated, which is why no further sharp increase in infection numbers is expected in the summer.

However, the virus mutations and especially the so-called delta variant, which is currently spreading rapidly, pose a risk, meaning that the exact development of the pandemic cannot be predicted. Travel warnings to countries where the mutations are particularly widespread are still in place for this reason. It is therefore advised to remain cautious and not to become reckless in order to prevent a renewed increase in the number of cases and restrictions in public life.

Changes in the organization of work in office:
With the number of cases of COVID-19 rising sharply across Germany and the upcoming lockdown Siemens urged all employees already in the beginning of March 2020 to work from home if possible, depending on the type of work and available setup. In addition to travel recommendations, business trips and internal meetings in Germany should be rescheduled or replaced by online meetings. Therefore, home office became the rule.

From 1st July 2021 German government will lift restrictions on home office and Siemens is currently developing guidelines to come back to work, however home office is still mandatory for all office personnel that can work from home. The same yields for business trips or meetings, which must be reduced to the absolute minimum and held virtually wherever possible.

The positive experience gathered in the last month led to the idea of "New Normal": After the pandemic, employees should be allowed to work on the move for 2 to 3 days per week, wherever possible and appropriate.

Changes in the organization of work in factories:

Considering the age structure in the participating factories it is clear, that COVID-19 had a huge influence on the organization of work in the factories. Already at the beginning of March, the management told everyone over 50 and with pre-existing conditions to stay at home for a longer period of time. External employees were no longer allowed to enter the factory. At the same time, there were many younger workers, including those who normally do other jobs (e.g., catering), who were willing to help or at least try to do easily explainable work to keep the factory running. At that time, the Ageing@Work idea of the AR/VR remote assistant gained a whole new importance, as factory management tried everything to allow the older workers at home to support the motivated younger staff in the factory. Various solutions to support the younger staff have been tested. However, the installation of several measures such as barriers, walls and the distribution/restriction of workers in the factory, especially the isolation of vulnerable workers, result in limited and restricted (only local staff is allowed access to the factory) work on site. Against this background, AR/VR solutions were given lower priority from the management perspective than originally expected.

2.3. Changes made in the D 2.1 after the European Commission recommendations

On October 10, 2020, a List of Actions Emerging from the 1st Review of Ageing Work was sent by the Commission to all project partners.

This list included a series of observations about D 2.1 and recommendations for the development of the future work.

System recommendations:

It was necessary to make a more detailed description of the use cases, especially regarding the way in which the system made recommendations to the user.

One of the requirements that was most clear in the previous deliverable 2.1, was that the system was not invasive to the user.

The system should be capable of warning users for potential incorrect choices, through utilizing rule-based (according to international recommendations) and predictive approaches (as for example presented in D3.2 in the context of prediction of sedentary behaviour).

The fact that the user does not want to follow the system suggestions is one of the possible outcomes. In this case, the scoring or rewards system plays a fundamental role, since a record will be kept with the suggestions given to the user and those completed by the user so that the user will be congratulated when the number of completed suggestions exceeds 70 % of those received at the end of the week.

In the event that the number of completed ones is below 70%, a message will be sent to the user that encourages him to follow the advice more actively.

All of these issues will be explained in more detail in section 4 of this deliverable.

Further details to be provided in other deliverables such as D4.2 and D5.3.

Rules for personalised suggestions

The rules for personalised suggestions were also developed in further detail. They are based on the information provided by the user in the `user profile´ that will be included in the Worker dashboard.

Privacy rules are followed by the designers and developers in order to ensure balance between personalization and privacy in the context of Ageing@Work Project.

Surveys

It has been decided to change the way in which the surveys were carried out, opting for an online modality, which has allowed reaching more users, especially a very high number of women.

The new surveys have especially sought to gather information about acceptance operating in real settings. The surveys have been reformulated to obtain data on the reception of suggestions by the user, their number and frequency.

Ethics and privacy issues were considered of high priority. More specifically new surveys have especially sought to respond questions related to data privacy.

In the survey section, the methodology is described in more detail.

Use cases reformulation

Use cases have been simplified, focusing the AR and VR solutions on a single pilot, Siemens, and allocating the ANEFA pilot to carry out tests on the virtual coach, the work platform and the job scheduling tool. Furthermore, Siemens agreed to conduct usability studies concerning the virtual coach.

In order to facilitate the results treatment, and the validation process, in addition to face-to-face tests, online tests have been introduced, so that a higher level of participation is obtained. In the reformulation of the use cases, we have sought to highlight the benefits/usefulness of tools in development and also achieve this synergy or interrelation between the tools.

As will be seen in the final use cases section, the knowledge exchange platform and the checklist have been integrated with the AR and VR solutions to improve the performance of older workers and safeguard their talent or experience.

The tools that focused on musculoskeletal problems and detection of stress and insomnia have been integrated into the worker's Dashboard, which has also integrated includes the avatar or Virtual Coach, which will be the tool that will give advice to the user.

As for the job scheduling tool, it has been improved to include other functionalities, such as the description of the worker's skills, so that work can be reorganized based on these parameters. The tools are integrated into three fundamental focuses: the older worker well-being, learning, and the organization of work according to the worker's skills, following the objectives set in the project.

Strategy on stakeholder's involvement

Concerning the strategy to include the companies in the implementation of the project, conferences and informative meetings have been organized since the project began to inform the companies and those responsible for health and safety, of the nature of the project and his objectives.

The companies whose workers are going to participate in the project have signed informed consents guaranteeing that they will facilitate the implementation of the project until its completion.

Therefore, the companies that will participate in the project, guarantee that they will allow the installation of the equipment that is precise and that they will facilitate the participation of the workers in the project, carrying out the adaptations that are necessary in the operations and in the work organization to that end.

As for those responsible for OSHA, they have had an active participation in the choice of user requirements, especially in terms of interaction and safety elements, as explained in D 2.1.

Regarding the involvement of stakeholders, in addition to conferences and informative meetings, one of the positive effects of the online survey has been that a large number of directors or owners of companies, those responsible for health and safety, and those responsible for personnel participated in it.

2.4. Influence on the Deliverable

The changes in work organization and workplace both in Spain and in Germany, as well as the recommendations received from the Commission, have led the Ageing@Work consortium to re-visit the proposed methodology as well as the proposed end-use cases and accordingly, further elaborate them.

Access limitations and security measures as well as the recommendations about the acceptance rate and privacy monitoring, have been especially considered to establish an online validation methodology, as will be explained in the next section.

These measures and recommendations have also been decisive for the redesign of the use cases, as will be seen in section 4 of this deliverable.

3. Methodology

In this section, the methodology used to prepare the second version of this deliverable is explained.

Since the present deliverable is an adaptation and improvement of the already delivered D2.1, and in order not to repeat what has already been explained in it, this deliverable reproduces the considerations made in point 4 of Deliverable 2.1 on the methodology, especially the ones related to the search parameters and the literature on which the user requirements and proposed use cases are based.
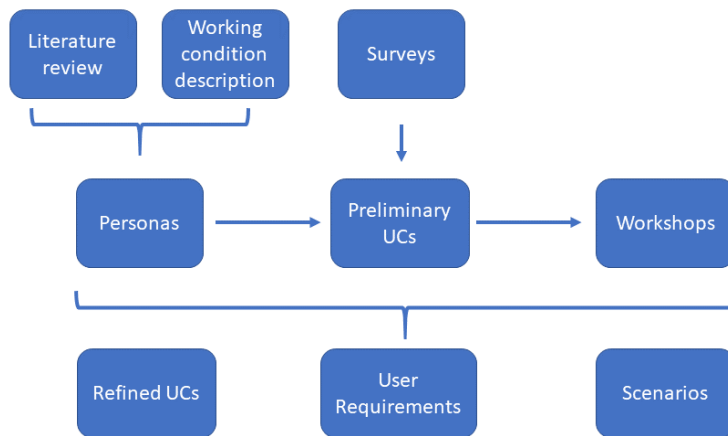
Figure 1: Methodology schema followed in D 2.1

Based on the results obtained in the previous deliverable, which resulted in the final use cases, revised use cases have been proposed considering the change in scenario caused by the pandemic and especially the recommendations made by the European Commission.

Once the use cases had been redesigned, online surveys were circulated among users, addressing the comments made by the Commission, especially regarding the measurement of the level of acceptance and privacy aspects, as will be seen later.

A new workshop has also been held in which the presence of women has been sought, so that end users can validate the proposed tools.

With all the information collected, the three final use cases have been developed.

Figure 2: Methodology schema followed in D 2.6

3.1 Refined use cases (RUC)

In accordance with what has already been stated on the effects of the Pandemic on the pilots and considering the recommendations made by the Commission, the use cases have been redesigned, considering the real possibilities of testing the tools with real users and prioritizing the project objectives and KPIs.

We have started from the user, design, functionality, and interaction requirements that resulted from the previous study of the literature, the user's needs, the previous surveys, the workshops, and the personal interviews.

In **ANNEX II**, summary tables are included with the data collected in D 2.1 on user requirements.

We have reduced the number of use cases going from the 7 use cases presented in D 2.1 to 3, to respond to the Commission comments and recommendations.

The use cases have been redesigned integrating the different solutions to obtain a more simple and comprehensive view of the use cases and more efficient design and evaluation of the proposed tools, taking elements from the use cases presented in D 2.1 so they continue to be present in the solutions proposed.

In this way, we start from the work already done in D 2.1 and from the basis of the user requirements that had been obtained through the literature, interviews, focus groups, and survey results, but improving the use case proposal in this deliverable looking for these objectives of simplification and integration.

The original plan on use cases articulated on deliverable D 2.1, included the realization of 7 use cases distributed between the Spanish and German pilots, among which were the following:

- **Use Case 1:** Check-list platform
- **Use Case 2:** Participatory work orchestration
- **Use Case 3.** Support for musculoskeletal problems
- **Use Case 4:** Supporting health and well-being-Virtual Coach
- **Use Case 5:** Knowledge exchange platform and intergenerational collaboration support
- **Use Case 6:** Productivity enhancement tools
- **Use Case 7:** Emergency button

As we have explained, the three new redefined use cases merge the use cases proposed in D 2.1 so that simplified and integrated solutions are created.

The following table explains his merging process:

Original use cases	Refined use cases
Check-list platform	AR / VR Tools & Knowledge Exchange Platform
Knowledge exchange platform and intergenerational collaboration support	
Productivity enhancement tools	
Support for musculoskeletal problems	Virtual Coach and Worker Dashboard

Supporting health and well-being-Virtual Coach	
Emergency button	
Participatory work orchestration	Job Scheduling Tool

Table 2: Original Use Cases-Refined Use Cases merging process.

The redefined use cases (RUC) have been reformulated into the following:

RUC 1: Virtual Coach and Worker Dashboard:

The Worker Dashboard is a web application that aims to empower workers and support their self-awareness about feasibility, health, and well-being through a visual representation of their data collected by the Ageing @ Work system.

The worker can use the platform going through its main functionalities, such as:
- `My Messages´, for communication with the different tools of the system.
- `My job´ to provide self-management of those work factors with a direct impact on their ability to work.
- `My goals´ for the establishment of personalized daily objectives in physical activities, free time and sleep habits.
- `My daily habits´, to transmit messages of self-awareness and motivation related to daily goals.

The virtual coach will be one of the tools included in the Worker Dashboard.

Through an avatar, the worker will receive advice, recommendations, and positive messages so that they can carry out activities related to their health, ergonomics at work or their well-being.

The user will receive messages of support and congratulations every time that he or she successfully carries out any of the recommendations made by the virtual coach.

According to the user requirements, the tool cannot be invasive or annoying for the worker, so if the worker does not complete the exercises or recommendations, he or she will only receive messages of encouragement to take into consideration the advice or recommendation in the future.

In case the user completes more than 70% of the submissions received, he/she will be congratulated at the end of the week.

A record will be kept in which the user can follow their evolution.

The two tools, the Worker Dashboard and the Virtual Coach, work synergistically, since they draw on the information that the user will enter about their personal habits, the work environment and their objectives, and both will work in a coordinated way. The aim of these tools is to jointly support health, quality of life and workability of the worker.

For example, it is important to take regular breaks from work to avoid prolonged immobility and prevent sedentary behaviours. The Ageing@Work Dashboard detects when the user is sitting for more than an hour without taking walking breaks. In this case, the Virtual Coach will ask the user to take a break and walk for five minutes. If successful, the system will congratulate the

user with a notification or a reminder to take a break. Also, when the user presses the notification, the main activity of the application will start, and the Avatar will read the message.

The Ageing@Work Dashboard uses Google Activity Recognition and a CNN model to estimate current user activity and develop a personalized activity recognition model, such as walking up or down stairs: The application checks if the user has climbed stairs in the last hours and, if not, the Ageing@Work Virtual Coach advises the user to climb the stairs. If successful, the app will congratulate the user with a notification. In any case, after 10 minutes, the service with CNN is deactivated to avoid discharging the battery device.

RUC 2: AR / VR Tools & Knowledge Exchange Platform:

Virtual reality learning tools provide the necessary framework for more experienced workers to create a virtual reality tutorial and load it into the application. On the other hand, less experienced workers can download a tutorial and train at home with a virtual reality headset or at the workplace with an augmented reality headset. In addition, the learning tools can provide training sessions for more experienced workers on new machines that they may need to learn to use.

The augmented reality platform aims to help workers in distance training, as well as into remote collaboration. The platform consists of two communication applications intended to be used by a remote supervisor (located, for example, at home) and a worker in the workplace, and uses intuitive digital instructions that enrich the physical environment of the workplace, thus facilitating the execution of tasks.

The knowledge exchange platform is a web interface that provides two-way access to the knowledge base and supports workers in the manufacturing process, allowing them to interact, collect and share relevant knowledge, ideas, and good practice.

RUC 3: Job Scheduling Tool:

The platform is designed as a web application for managers, coupled with the Ageing@Work mobile app of the workers, facilitating participatory work orchestration. Different aspects of the organization are available, such as an overview of the organization's daily, weekly, and monthly tasks, an overview of the workforce and their skills. Task assignment is supported by a background DSS that helps the manager to distribute the tasks and can reschedule the tasks assigned to the workforce after a change, for example when a day off is requested.

An initial clustering of the preliminary use cases categories per Pilot site follows in the Table below.

Service/application	Germany	Spain
Virtual Coach	✓	✓
Worker Dashboard	✓	✓
AR Tools	✓	
VR Tools	✓	
Knowledge Exchange Platform	✓	
Job Scheduling Tool		✓

Table 3: PUC per pilot

3.2 Surveys

As stated above, the methodology for updating the information regarding user requirements has been based on conducting online surveys, modifying their content in accordance with the recommendations received from the Commission.

In the following sections, the modality and contents of the survey will be carried out and the results obtained by ANEFA and Siemens will be analysed separately, taking into account the different profiles of the participants.

In order to reach as many participants as possible, the opinion of workers over 45 years old who are not directly related to the pilots has been sought. In other words, workers not belonging to ANEFA or Siemens have been asked to administer the surveys, thus enriching their results. We will call this group `off-pilot group´.

3.2.1 Online surveys

As previously analysed, the COVID-19 pandemic has led to the governments of the different states having approved measures limiting mobility to prevent the spread of the virus. This, in addition to the measures that the companies themselves have adopted limiting entry to outsiders, have led us to consider as the only possible way to collect the necessary data for updating D 2.1. surveys in online mode.

For its administration, we used "Google Forms" platform, as it is a simple tool both for its elaboration and completion.

For its preparation, a participatory process was carried out in which the consortium partners made contributions.

We started from the previous format of the surveys already carried out, making the necessary modifications considering the recommendations made by the Commission.

Thus, specific sections were included to measure the degree of acceptance regarding the receipt of recommendations by the tool, as well as to measure issues related to privacy and data management. Depending on the use case, data with different levels of sensitivity will be collected. Thus, for example, regarding the worker's platform and the Virtual Coach, personal and health data will be processed, which will require an informed consent from the user and apply a specific procedure for its treatment and management. For other tools such as learning tool or work scheduling tool, less sensitive data will be handled.

Regarding the methodology followed for the treatment of data and privacy, it is explained in detail in deliverable 7.2, although here we can point out that the methodology has focused on the way in which the data will be treated; how they will be stored; the person who will be responsible for their treatment and management: the way in which they will be interpreted and the indicators of success.

It was decided to structure the surveys in three parts, one for each of the proposed solutions: Virtual Coach and Dashboard, VR and AR tools and knowledge exchange platform; work organization tool.

In all of them, the participant is asked for data on work experience, frequency of use of technology and type of applications used, well-being and satisfaction at work as well as for the management of personal data.

In addition, for each of the surveys, videos have been included with the demonstrations of the tools and images, so that the participants have the chance to have a closer contact with the proposed solutions.
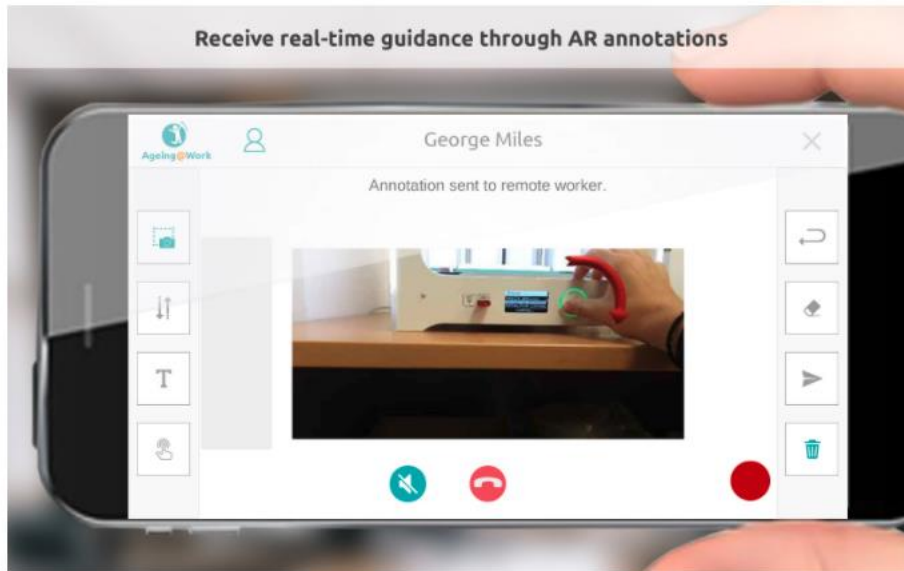
Figure 3: AR Tool explanatory image

Figure 4: Remote worker collaboration image tool.

Video 3: Please watch the video below to see how worker collaboration based on Augmented Reality and the placement of virtual annotations can be achieved
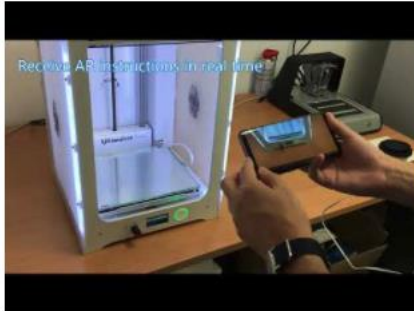
Figure 5: Link to AR/VR Demo
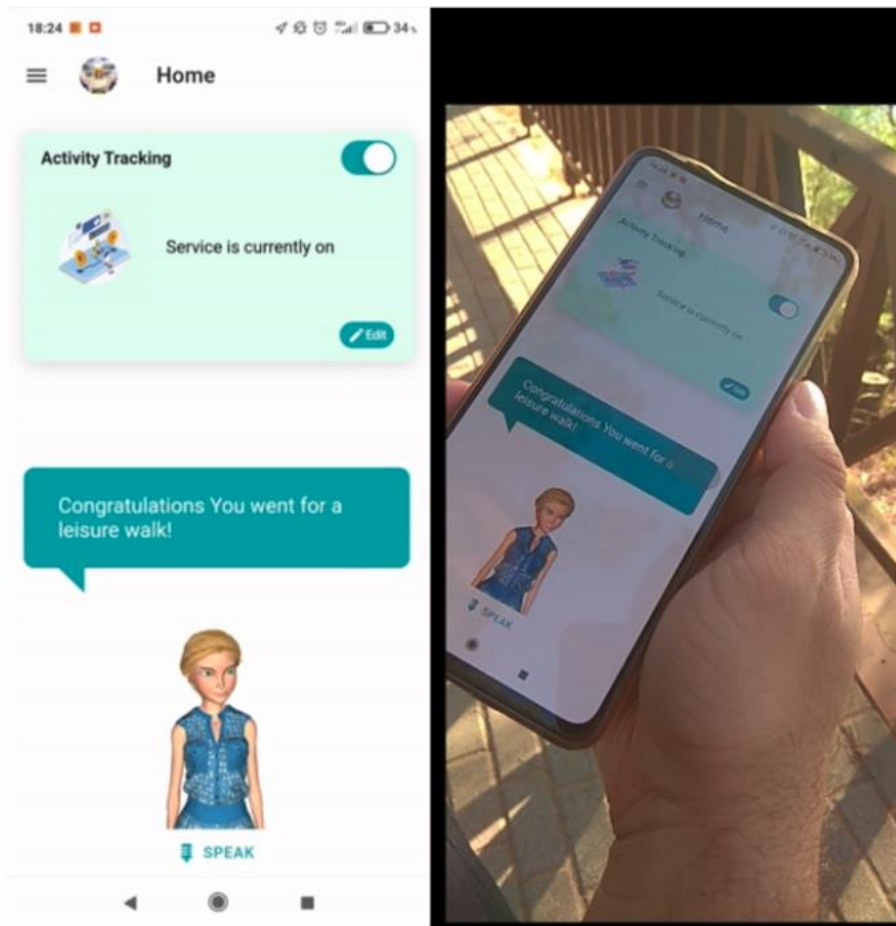
Figure 6: Virtual Coach explanatory image

Video 1: Please watch the below video to see the Virtual Coach recommending breaks at work
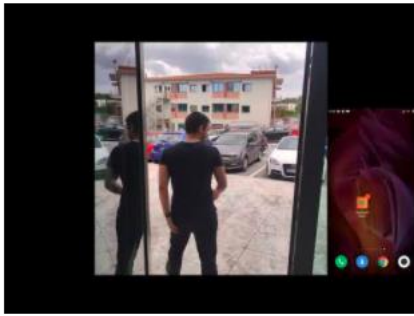
Figure 7: Direct link to the virtual coach demo

In the specific part of each tool, participants have to answer questions about the level of acceptance of the system and about specific functionalities of each one of them.

Once the final version of the surveys, which we include in the ANNEX, was completed, two versions were made, translated into local languages, one in Spanish and one in German to be managed by each of the pilots.

Advantages of the online survey

Fast shipping:
The online survey can be addressed to a large group of people instantly, without the need to travel or come into direct contact with the respondent. This saves considerable time by reaching potential participants instantly and efficiently.

For example, in ANEFA, the previous survey modality that was used was the face-to-face survey, which was given to workers in aggregate companies, taking advantage of the situation where face-to-face mining safety courses were being held. The surveys were delivered to the workers over a period of 4 months, with a large investment in time and resources.

With the online survey, a similar level of participation has been obtained in a period of three weeks, which leads to think that the number of final participants will be higher.

Quick response:
The participant responds more quickly to questions asked through online surveys than through other information gathering methodologies.

Possibility of inclusion of interactive content:
In these online surveys, we have included videos with the demonstrations of the proposed tools, which together with their description, allow the respondent a greater knowledge of the proposed solution and therefore, give a more informed response.

Greater breadth in the profiles:
Through online surveys, we have been able to reach respondents with different profiles compared to those previously interviewed. In fact, a broad female participation has been achieved, which, being a profile more united to management, was not so present within the profile of the common operator. In addition, interest groups such as directors or owners of companies, experts in health and safety, lawyers, people dedicated to training or research in

mining, etc., have been easily reached, who would have been especially difficult to reach with the face-to-face modality. Therefore, we have enriched the profile of the respondent.

3.2.2 ANEFA´S surveys, preliminary analysis

The ANEFA surveys were launched on May 5, 2021.

During the first four weeks, we have obtained 125 responses to the surveys.

In the previous conducted surveys, since training courses on occupational risk prevention and workers' health, subsidized by the Ministry, were organized by the association, ANEFA took this opportunity to deliver the surveys to the workers, achieving a total participation of 101 workers, for 4 months, thus, thanks to the online surveys, we have increased our numbers.

The survey´s format carried out by ANEFA is included in ANNEX III to this document.
In the following chapter, statistical data obtained from the surveyed workers will be presented.

3.2.2.1 Participants' profile:
This section is focused on the profile of the workers that were surveyed.

Age:
It is important to point out that even though the Ageing@Work solutions are designed for workers between 45 and 65 years old, it was decided to extend this survey to all workers regardless of their age and job. To this end it was feasible to draw conclusions about the future of Ageing@Work solutions and stablish if the results obtained with potential users can be maintained in the medium and long term.

Thus, 21.9% of the total respondents are under 45 years of age.

Of the total of those surveyed, 79.1 exceeds 45. Of the range between 45 and 62, 36.55% are between 54 and 62 years, with the bulk of those surveyed being the range between 45 and the 53, with 41.55%.

If these results are related to those obtained in the previous survey, there is a balance in terms of the representativeness of the age groups, since the most represented group, between 45 and 53/54, continues to obtain a similar percentage of participation (in D 2.1, the number reaches 44%).

There are important differences in terms of participants over 54 and under 45. The difference of 12% to 36.55% in the surveys of d 2.6 with respect to the 54-65 group is since most of the answers obtained come from people in positions of responsibility, in which the average age is older.

In addition, office staff are not subject to the risks of the operators, so they could not request early retirement.

AGE	45-54 (44%)	54-65 (12%)	<45 (44%)
GENDER	Male (96%)	Female (4%)	

Table 4: Participant profile results D 2.1.

Gender:
As already mentioned, thanks to the online format, a broad participation of women has been obtained with respect to the previous results, going from 4% to 50% women and 50% of men.

Professional profile:
Regarding the professional profile, there is a substantial change with respect to the majority profile of the previous surveys, since we went from main profile of quarry operators (91%) to 54,8% of worker dedicated to office work or management with 35,5% dedicated to "other profiles", among which we find: 8,3% managerial profiles; 4,21% dedicated to training; 4,21% dedicated to legal advice; 8,3% of quarry managers;4,21% laboratory technicians; 4,2% from other office staff and 4,2% human resources.

Years of professional experience:
Regarding the years of professional experience, the profiles of a worker with a lot of professional experience, in fact 93.5% of those surveyed have more than 15 years of experience, of which 41.9% have More than 25 years of experience.

Highest level of education completed:
According to the majority profile of leadership or management, 75.8% of those surveyed have university studies, with 24.2% of those surveyed having received professional or non-university training.

AGE	45-53 (41,55%)	54-62 (36,55%)	<45 (21,9%)

GENDER	Male (50%)	Female (50%)	
ACTUAL JOB			
o Office worker		54.8%	
o Plant operator		1,6%	
o Maintenance		6,5%	
o **Mobile machinery operator**		8,1%	
o **Other**		35,5%	
o **Remote technical assistant**		3,2%	
YEARS OF WORK EXPERIENCE			
0-5		1,6%	
6-10		3,2%	
10-15		1,6%	
15-20		24,2%	
20-25		27,4%	
More than 25		41,9%	
HIGHEST LEVEL OF EDUCATION COMPLEATED			
Primary School		0%	
Secondary School		11,3%	
University		75,8%	

Masters	0%
Doctorate	0%
Vocational training	12,9%
Other	3,2%

Table 5: Participants' profile in ANEFA
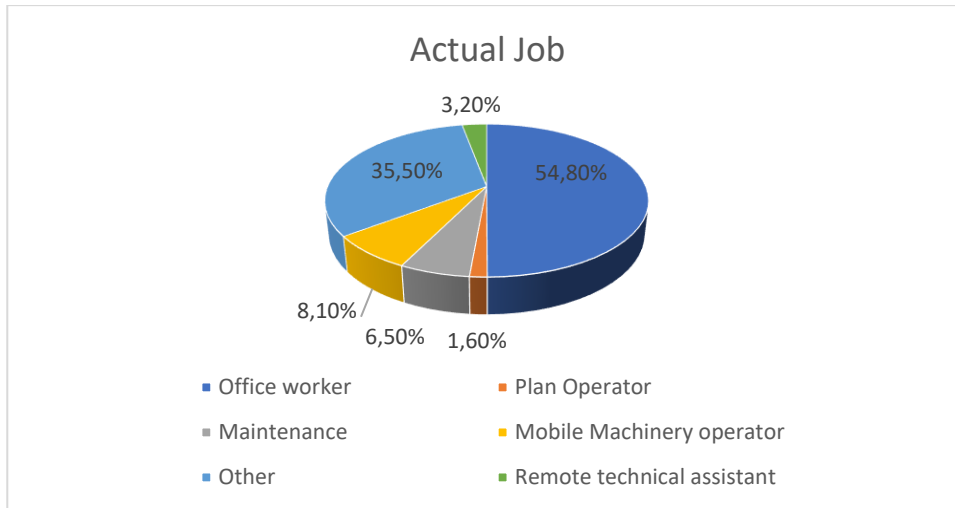
Figure 2: Graphic on actual job position-miners profile

The results obtained through these new surveys have allowed us to cover a much larger spectrum of mining professionals, thus including the opinion of actors who had not been previously involved.

Furthermore, a very positive result is that a large percentage of women have participated in the surveys, thus responding to one of the main comments of the Commission.

3.2.2.2 Data on Frequency in technology use

FREQUENCY ON TECHNOLOGY USE					
With what frequency do you use the internet?	*NEVER*	*ONCE A WEEK*	*MORE THAN ONCE A WEEK*	*EVERYDAY*	
	0%	0%	4,8 %	95,2%	
With what frequency do you use apps?	*0%*	4,8%	8,1%	87,1%	
What kind of apps do you use more frequently?	*Health apps (e.g., mobile apps)*	*Social Media (e.g., Facebook, Instagram)*	*News*	*Weather apps*	*Other*

Never	22,2%	19,04 %	4,76%	1,58%	28,57 %
Rarely	39,68 %	19,04 %	9,52%	31,74%	14,28%
Sometimes	22,2%	19,04 %	26,98%	31,74%	34,9%
Daily	15,87%	41,2%	58,73%	36,5%	23,8%

Have you ever used and smartwatch or vital measurement tools?	NEVER		RARELY		USUALLY	
	33,9%		27,4%		38,7%	
Have you ever used AR tools?	75, 8%		24,2%		0%	
Have you ever used VR tools?	58,1%		41.9%		0%	

Table 6: Data on frequency in technology use

Regarding the data on frequency of use, if we compare them with the previous results, we see how this new surveyed group has a much closer and continuous relationship with new technologies, the use of apps, smartwatches, or AR / VR tools. Those responsible for companies must be up to date with the most advanced technological solutions to include them in the day-to-day running of their companies and in their business models.

The results of the respondents on the proposed use cases will be a great added- value for the project, to the extent that we will have the opinion of workers with a close relationship with the proposed technology.

3.2.2.3 Data on work related well-being

WORK RELATED WELL BEING					
Aspects of the job position	Totally Unsatisfied	Unsatisfied	Neutral	Satisfied	Totally satisfied
The physical conditions of the work	0%	3,2%	27,41%	41,93%	27,41%
Hours of work per day	3,22%	11,29%	22,5%	40,32%	22,5%
Security at work	1,61%	4,8%	1,61%	48,38%	45,16%
The amount of responsibility entrusted to you.	1,61%	4,8%	11,29%	46,77%	35,48%

Table 7: Data on work related well-being

ASPECTS OF THE JOB POSITION
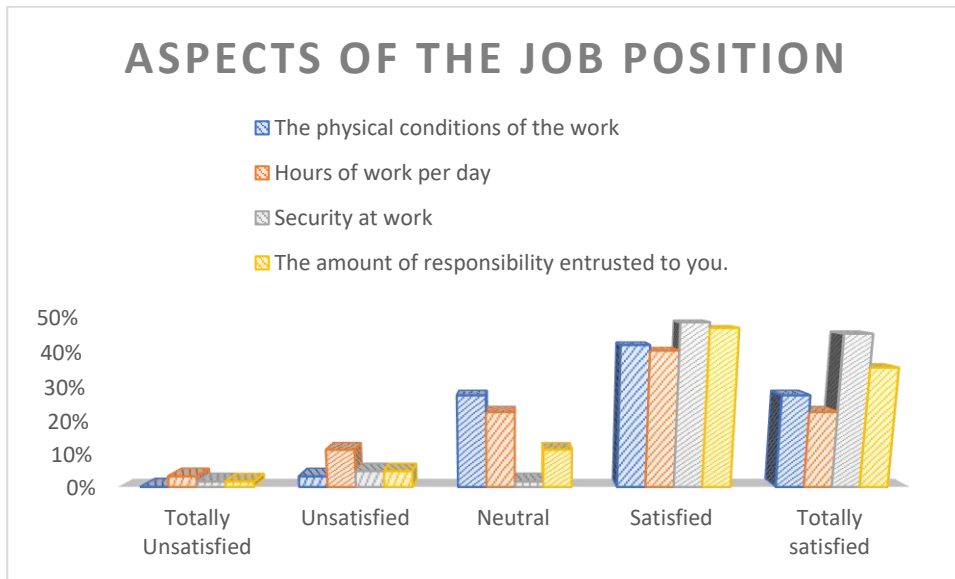
Figure 3: Graphics aspects of the job position-miners profile

Most of the respondents are satisfied or totally satisfied with aspects related to well-being at work, such as the physical conditions of the work, hours of work per day, security at work and the amount of responsibility entrusted.

The aspect that obtained the worst results is the one referred to the number of hours dedicated to work, with which 14,5% are considered unsatisfied or totally unsatisfied.

A tool that helps the worker to optimize his leisure and work time, such as the one proposed through the worker's Dashboard, can be very positive to increase this well-being at work.

3.2.2.4 Data on job satisfaction and job engagement

JOB SATISFACTION AND JOB ENGAGEMENT			
VIGOR			
At my work, I feel bursting with energy.	Never	Sometimes along the year	Usually along the year	Daily
	1,61%	12,9%	67,74%	17,74%
At my work I always persevere, even when things do not go well.	0%	8%	62,9%	29%
DEDICATION			
To me, my job is challenging.	*1,61%*	17,74%	40,32%	40,32%
My work inspires me.	3,22%	20,96%	46,7%	29%
ABSORPTION			
Time flies when I am working.	0%	16.19%	54,83%	29%
I feel happy when I am working intensely.	0%	22,5%	51,6%	25,8%

Table 8: Data on job engagement

Regarding the vigour results, the majority of the surveyed considered that usually along the year at their work, they feel bursting with energy and that they persevere, even when things do not go well.

Although the results are generally good, they can be improved through tools that help to raise the level of energy and the level of perseverance. Thus, in the worker Dashboard, tools are included to measure the quality of sleep and stress levels, so they can help to improve these parameters.

Knowledge sharing and AR / VR tools can also be used to help workers persevere in difficult processes and achieve better results.

The percentages decrease in relation to the parameters related to work dedication. Only 40,32% consider that their work is challenging on a daily basis, whereas 29% feel inspired by their work daily, and 46.7% consider themselves regularly inspired. These results are explained because the high level of experience in the position can lead the worker to get used to their tasks and their work to become monotonous. To avoid this, it is useful to make changes in the way you organize and distribute tasks, making work more enjoyable.

Thus, through the job scheduling tool, it is possible to control the frequency with which tasks are assigned to a worker, assigning him others so that his performance becomes more dynamic.

In addition, the Dashboard will propose ways to optimize the free time of the worker so that they go to work with greater optimism and with renewed energy.

Regarding the work absorption, more than 50% consider that, usually, time flies when they work, and feel happy when they work hard. To improve these parameters, we can make the same considerations about the usefulness of the job scheduling tool and the worker Dashboard.

The knowledge exchange platform can make a positive change in the workability of the mature worker, introducing new training objectives for himself and to help younger workers, so that he or she feels more useful for longer, and maintains or increases the feeling of belonging.

3.2.2.5 Data on technology acceptance, functionalities, privacy, and security

As a differential point comparing to the previous surveys, and following the recommendations of the Commission, the surveys included questions to gather data regarding technology acceptance on proposed tools. They have been specifically asked about the perception of usefulness and usability, intention to use and self-efficiency attributed to the tool.

Moreover, specific questions about the functionalities of the tools are added.

Finally, questions about security and privacy aspects complement the surveys.

The following tables analyse the results for each of the tools described above.

WORK PRODUCTIVITY TOOL THROUGH VIRTUAL REALITY/AUGMENTED REALITY & KNOWLEDGE EXCHANGE

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Learning to use the Work Productivity tool would be easy for you	64,5%	33,8%	1,61%	0%	0%
Your interaction with the Work Productivity tool would be easy	64,5%	30,64%	3,2%	1,61%	0%
It would be easy for you to become skilful at using this tool	37,09%	41,9%	16,1%	3,2%	1,61%
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Using the knowledge exchange platform would enable you to communicate better (such as by uploading videos, images, documents) with your colleagues and accomplish your work tasks better	61,29%	25,8%	11,2%	1,61%	0%

Using the knowledge exchange platform would save time in works' performance	37,09%	38,7%	19,3%	1,61%	3,2%
You would find this tool useful in your job	43,54	38,70%	16,1%	1,61	1,61%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If you could use this working tool to support you at work, you would appreciate working with	37,09%	43,54%	14,51%	3,22%	1,61%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use this tool if someone shows you how to do it first	59,67%	29,03%	9,67%	3,22%	0%

Table 9: Data on technology acceptance
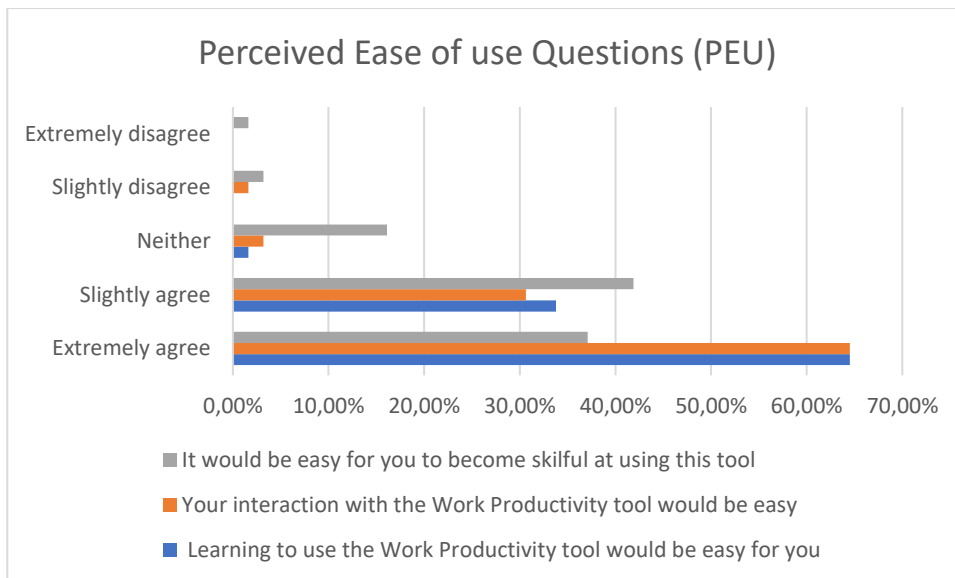
Figure 4: Graphic on PEU-AR/VR-miners

Perceived Usefulness Questions (PU)
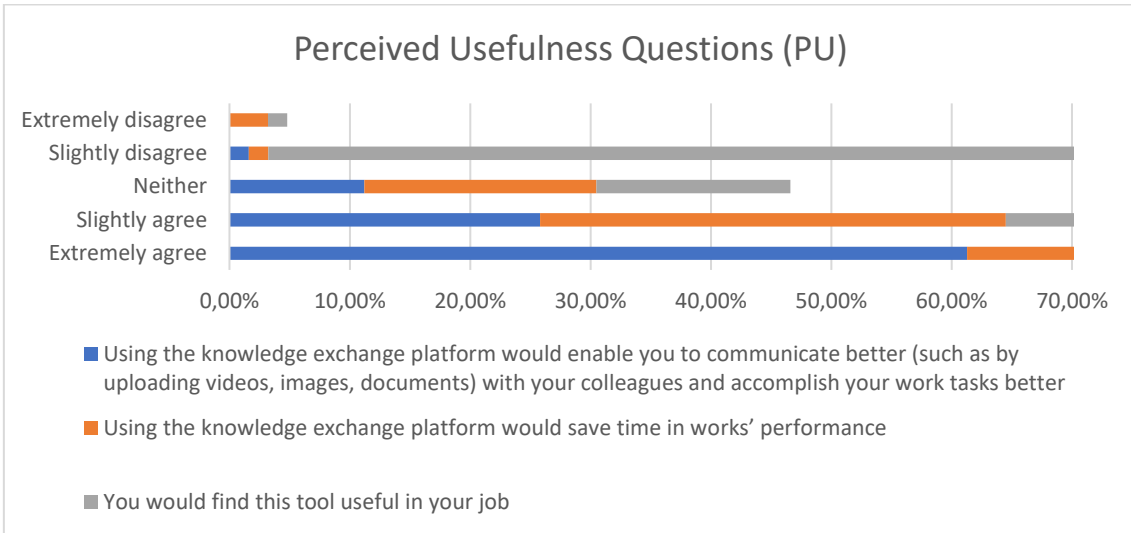
Figure 5: Graphic on PU-AR/VR-miners

Behavioural Intention to Use (BI)
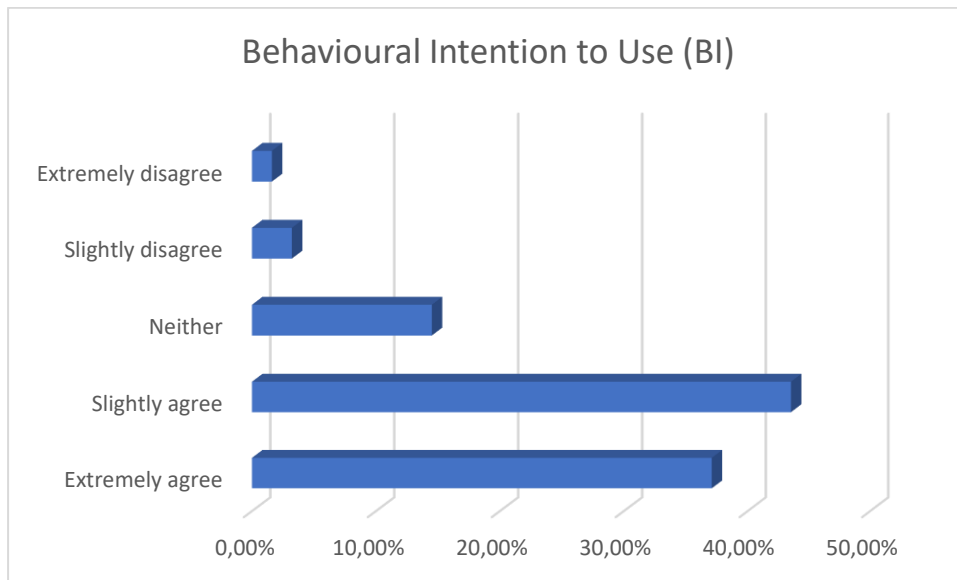
Figure 6: Graphic on BI-AR/VR--miners

Figure 7: Graphic on self-efficacy AR/VR-miners

Are you aware of VR/AR training tools at workplaces?
- Yes, I am. 17,7%
- I have heard about it before 21%
- No. 61,3%

You would be interested in using VR/AR as a training/learning tool?
- No 11,3%
- Yes 88,7%

Would you think that the VR/AR tools and the knowledge exchange platform could help you and your colleagues to work faster and more efficiently?
- They sound appealing to me 72,6%
- I will be engaged in such tools 17,1%
- I prefer the traditional training methods 11,3%
- I would not like to try them 3,2%

Results:

The results on the level of acceptance of the technology are very positive regarding the AR / VR tool and knowledge exchange platform.

Regarding the perception of ease of use, the lowest percentage is obtained with respect to the ease of becoming an expert in its use. This reveals a certain reluctance of the user, considering it difficult to use this type of tool. This is explained because, according to the results on frequency of use, most users have never used VR / AV tools.

Therefore, from the results among the lessons learnt was that the tools will have to be simplified so that they are easy to use for the average user, putting the effort into training.

Regarding the level of perceived usefulness, the worst result is obtained with regard to considering the tool as a means to save time in carrying out tasks.
This, based on the previous result, is explained because the user finds it complex to become an expert in the use of the tools, so that it will take time to use them.

That is why here we repeat the previous considerations regarding the need to simplify the tool and make it more intuitive.

These conclusions are supported by measuring self-efficacy, so that about 60% of the respondents fully agree that they could use this tool if someone first showed them how to operate it.

In addition, when asking the participants specific questions about the technology, more than 80% consider them attractive and close to 90% would be interested in using it. Therefore, the user in the extractive industry is curious about these types of tools and perceives them as useful.

A main lesson learnt is that we should focus on training to help the user to use the tool efficiently.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that this data will be used by your organization in an aggregated and anonymised way, how much concerned are you about data privacy protection?	6,45%	53,22%	30,64%	11,29%
Having in mind that the information of the knowledge-sharing platform will be invisible to outsiders and /or third persons, how much concerned are you about data privacy protection?	8,06%	50%	29,03%	12,9%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that secure policies have been defined as part of the project to protect your privacy and confidentiality, how much concerned are you about VR and AR technologies use for?	12,9%	61,29%	24,19%	1,61%
Having in mind that authentication and authorization will be used strictly according to knowledge exchange through VR/AR, how much concerned are you about your data security? outsiders and /or third persons, how much concerned are you about data privacy protection?	9,67%	61,29%	22,58%	6,45%

Table 10: Data on privacy and security questionnaire
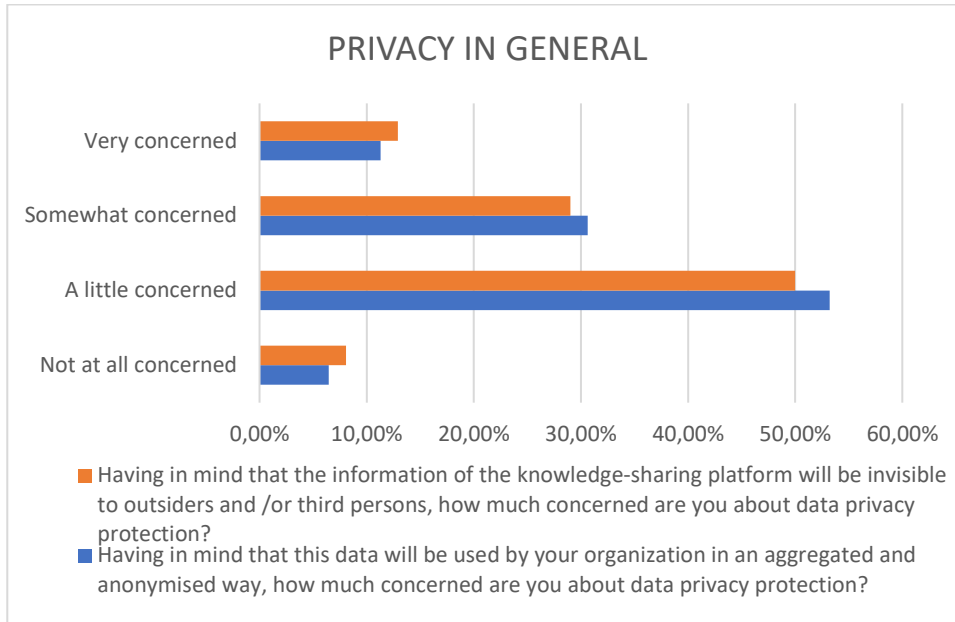
Figure 8: Graphic results on privacy in genera-AR/VR-miners
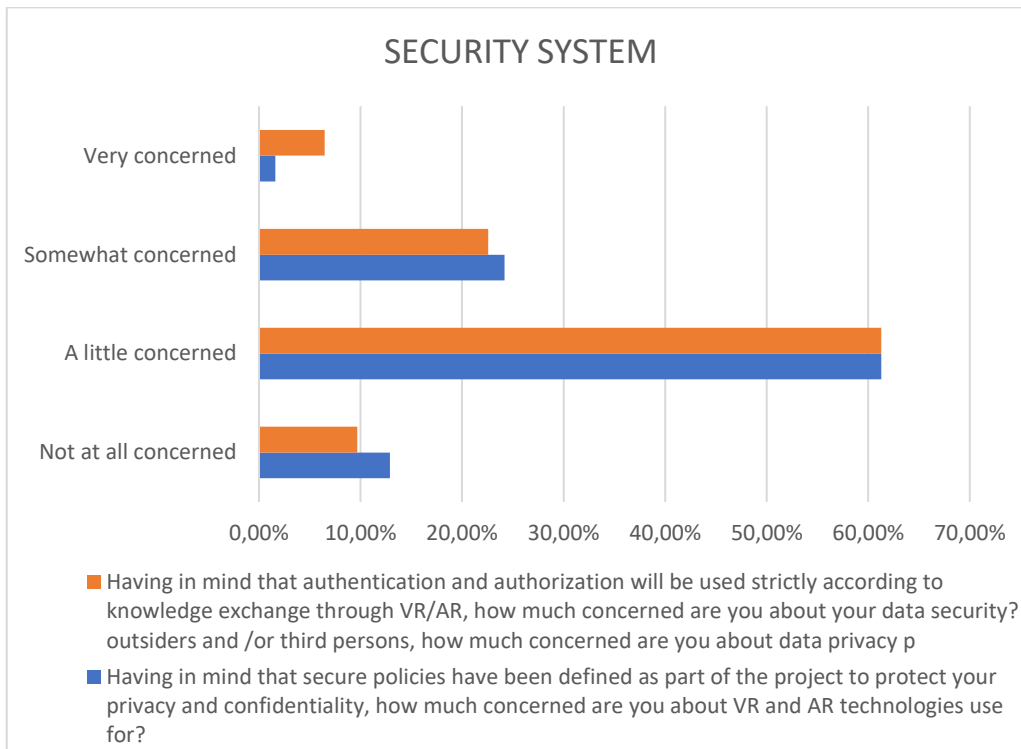
Figure 9: Graphic on results about the security system-AR/VR-miners

The majority results on issues related to the treatment of private data and security issues show little concern form the potential users.

While it is true that most of the results lead us to conclude that concern regarding security and privacy issues is low, there is a percentage of between 25-30% that shows moderate concern about these issues.

However, even if the user does not perceive obvious concerns, security and privacy issues are listed in high priority considerations, so in the management and data treatment, strict security measures will be followed, in compliance with data protection regulations.

VIRTUAL COACH & WORKER DASHBOARD

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
The virtual coaching tool was clear and easy to understand	73,3%	26,6%	0%	0%	0%
It would be easy for you to interact with the virtual coaching tool	56,67%	40%	0%	3,33%	0%
It would be easy for you to learn to use the virtual coaching tool	60%	36,6%	3,33%	0%	0%
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Receiving virtual coaching recommendations would provide you useful measurements for your health (for instance your cardiac rhythm)	66,7%	30%	3,33%	0%	0%
Using virtual coaching services such as emergency buttons would help you address effectively emergency situations at your work.	66,7%	26,6%	6,66%	0%	0%
Virtual coaching advice/recommendations during the working day would be useful as a motivation to change your health habits whenever is necessary	50%	43,33%	3,33%	3,33%	0%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If possible, you will try to use such a virtual coaching solution	46,67%	43,3%	6,67%	3,33%	0%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use the virtual coaching tool if someone shows you how to do it first	70%	20%	6,7%	3,3%	0%

Table 11: Data on Technology acceptance

Perceived Ease of use Questions (PEU)
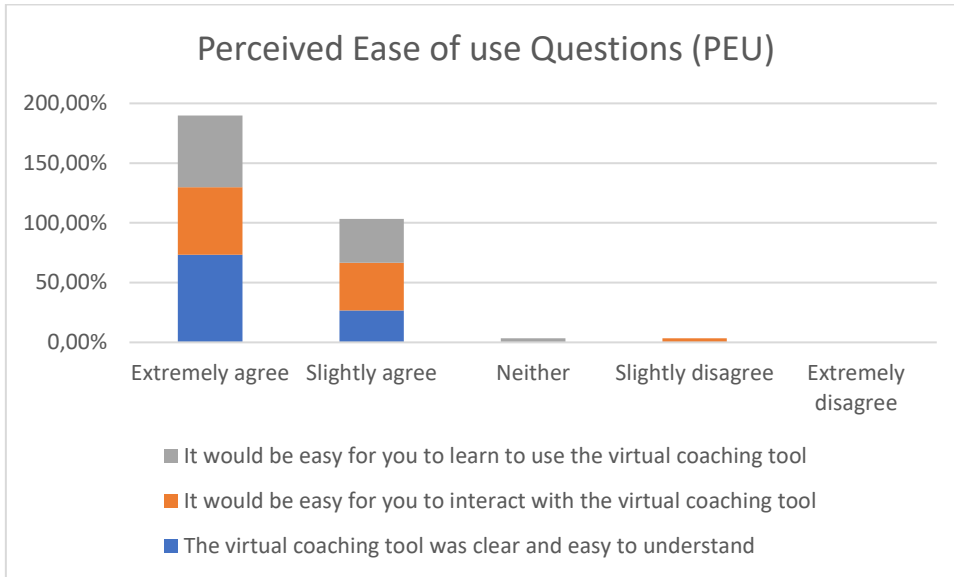
Figure 10: Graphic on PEU Virtual Coach-miners

Perceived Usefulness Questions (PU)
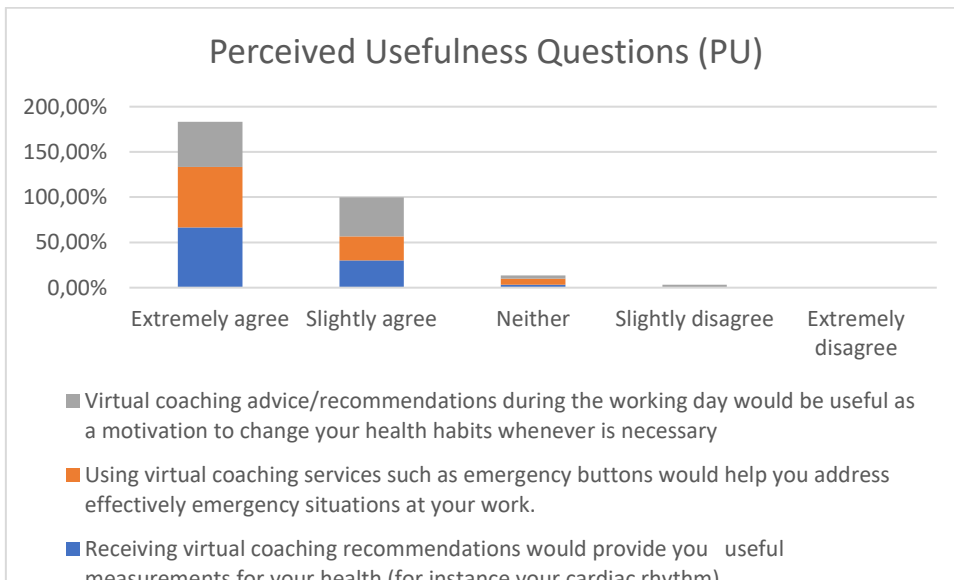
Figure 11: Graphic on PU Virtual Coach-miners

BEHAVIOURAL INTENTION TO USE (BI)
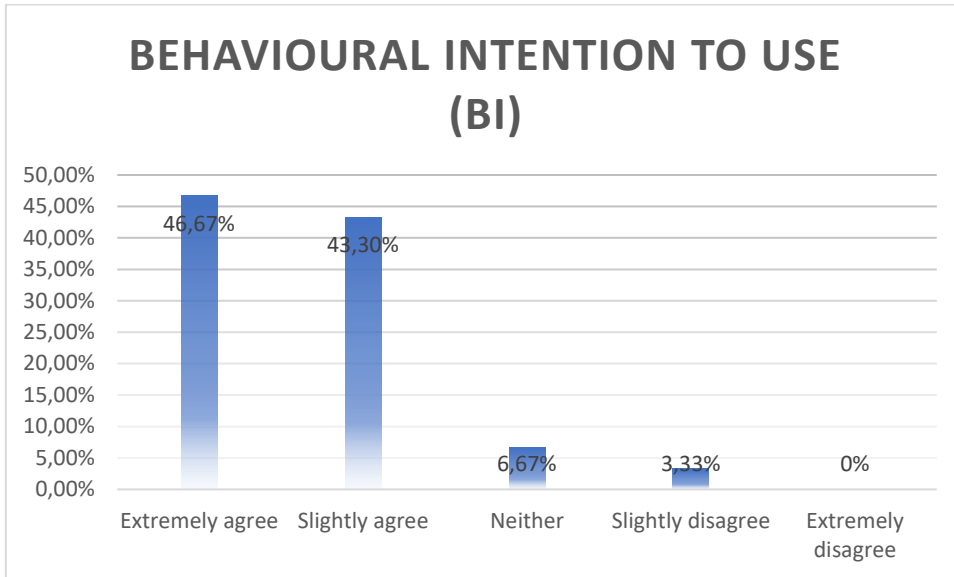
Figure 12: Graphic on BI Virtual Coach-miners
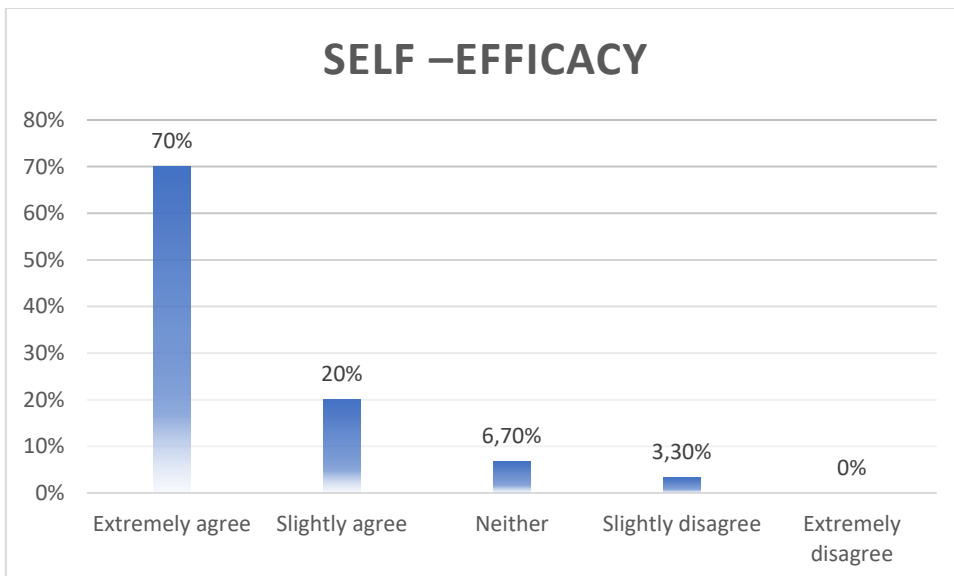
SELF –EFFICACY

Figure 13: Graphic on self-efficacy Virtual Coach-miners

VIRTUAL COACHING ADDITIONAL FUNCTIONALITIES' ASSESSMENT
You would be interested in receiving advice for your health and well-being via your mobile phone/smartphone?
- Yes 96,7%
- No 3,3%

If yes how many messages would you be interested in receiving?
- Less than 1-2 messages per week 10%
- 1-2 messages per week 23,3%
- 3-4 messages per week 13,3%
- 1 message per day 43,3%
- 2 messages per day 10%

If the answer is "no" explain briefly why:

"Because my work and my obligations cannot depend on what an app says."

You would be interested to receive feedback about your daily score of achieving healthy activities also in respect to your performance the previous days/weeks
- Yes 93,3%
- No 6,7%

Would you be interested in receiving recommendations from the virtual coach about how to organize your work time? (For example, when to take a break or take a day off)
- Yes 86,7%
- No 13,3%

If yes, please explain what kind of recommendations you would like to receive
- break reminder and healthy to do suggestions during it (e.g., go for a walk, have a healthy snack)
- when to take a break
- I need it to organise and prioritize my tasks
- Mobile alert.
- when to take a day-off
- Office ant sedentarism
- Stretching

Results:

Regarding the perception of the ease of use of the tool, all the results show positive results, since the participants consider that the virtual coach tool is clear and easy to understand, and that it will be easy for the user to use the tool (73% of respondents are extremely in favour).

The result is less consistent with respect to the ease of interaction with the virtual coach. The demo content shows how the worker receives advice from the VC and follows them, but there is no information about the worker starting a conversation with the coach.

Following the Commission's comments, a means of interaction with the VC should be included if the worker is not able to follow the recommendation.

In such a case, the VC should be able to send a message of encouragement to the worker and send recommendations at another time.

When participants have expressed their opinion on the usefulness of the Virtual Coach as a way to improve their health, the results have been positive with 96% of the participants agreeing or quite agreeing that it will be useful for the coach to measure these parameters.

This can be derived from the close relationship that respondents have with measurement items such as smartwatches or Fitbit wristbands. It is also considered very useful for the virtual coach to include the security button in its services to be able to respond quickly in emergency situations.

The greatest reluctance exists regarding the usefulness of receiving recommendations during work time. This reluctance is logical since the employee may be immersed in a task and not have enough time to check their device and see if the avatar has made a recommendation. That is

why the Virtual Coach must be respectful with the performance of the worker and not conflict with the development of their tasks.

Recommendations must be made in such a way that the user can access them during their breaks at work or in their free time.

Regarding the Behavioural Intention to Use (BI), 90% strongly agree or quite agree that, if possible, they would like to try the Virtual Coach and the Dashboard.

Regarding self-efficacy, 90% strongly agree or agree that they could use the virtual coach if someone taught them how.

Again, we are facing a public of workers for whom this type of tools may seem strange, so it will be essential to focus our efforts on education and training.

Finally, when asking users specific questions about how often they think they should receive recommendations, and the nature of them, a minority percentage of respondents would like to receive two messages a day (10%). The highest percentages of frequency are those referred to 1 message a day (43,3%).

However, when asked if they would be interested in receiving feedback on their daily results or recommendations on how to organize work time, a vast majority would agree to receive these types of messages.

The workers find the recommendations useful, and even make suggestions about the content they would like to receive, but do not want to feel "overwhelmed" by the virtual coach. It is essential to design the tool in a way that is not invasive in working time.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that only you and authorised people will have access to the virtual dashboard data, how much concerned are you about your data privacy?	16,6%	46,67%	30%	6,67%
Having in mind that this information will be processed through anonymization methods, how much concerned are you about your personal data privacy while using a virtual dashboard?	20%	36,7%	36,7%	6,67%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that the virtual coaching targets to provide healthy lifestyle suggestions for your overall health improvement, how much concerned are you about data security?	13,37%	46,67%	33,3%	6,67%

Having in mind that the virtual coaching provides you the potential to have an overview of your health-related data and quicker access in this data in case of emergency, how much concerned are you about the collection of this data?	13,37%	43,33%	36,6%	14,28%

Table 12: Data on privacy and security questionnaire

Despite the fact that the statement itself explains that an anonymization process will be carried out and that only authorized personnel will have access to its measurements, the concern is logical to the extent that especially sensitive data will be processed.

An effort is required in the data treatment methodology, to provide security measurements and initiate a trustworthy environment to the participants, avoiding also any type of leakage or failure in the treatment that could jeopardize the objectives of the Project.

MANAGER'S JOB SCHEDULING TOOL

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Learning to operate this tool would be easy for you	45,45%	48,48%	6%	3%	0%
You would find it easy to get this technology (or tool) to do what you want it to do	30,3%	57,57%	12,1%	3%	0%
It would be easy for you to become skilful in the use of this tool	36,36%	48,48%	15,15%	3%	0%
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Using the information of vacations and absences provided in the Work-Scheduling tool would help you assign effectively work tasks per individual worker saving time and cost	54,54%	36,36%	9%	0%	0%
Using the Work-Scheduling tool daily notifications would be a good practice to support workers' daily tasks	60,06%	30,03%	9%	0%	0%
Using this tool, the overall time and	57,57%	27,27%	12,12%	3%	0%

quality of your work would be improved					
Using this tool better exploitation of workers skills would be possible	60,06%	24,24%	12,12%	3%	0%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If you could use this tool, it to support you at your work, you would appreciate working with this	45,45%	27,27%	27,7%	0%	0%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use this tool if someone shows you how to do it	54,54%	36,36%	9%	0%	0%

Table 13: Data on technology acceptance
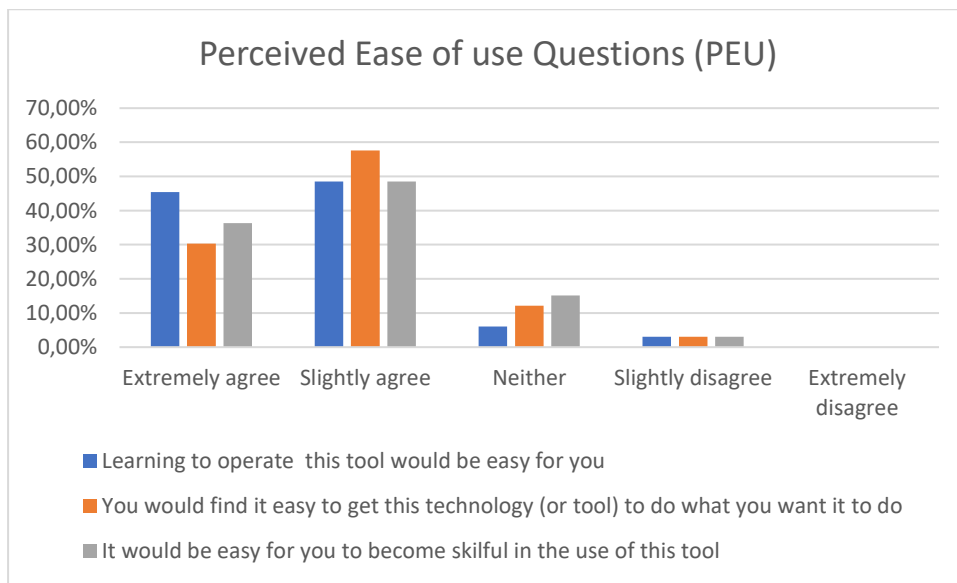
Figure 14: Graphic PEU Job Scheduling-miners

Perceived Usefulness Questions (PU)

- Using this tool better exploitation of workers skills would be possible
- Using this tool, the overall time and quality of your work would be improved
- Using the Work-Scheduling tool daily notifications would be a good practice to support workers'…
- Using the information of vacations and absences provided in the Work-Scheduling tool would help…

0,00% 10,00% 20,00% 30,00% 40,00% 50,00% 60,00% 70,00%

■ Extremely disagree ■ Slightly disagree ■ Neither ■ Slightly agree ■ Extremely agree

Figure 15: Graphic PU Job Scheduling-miners

BEHAVIORAL INTENTION TO USE (BI)
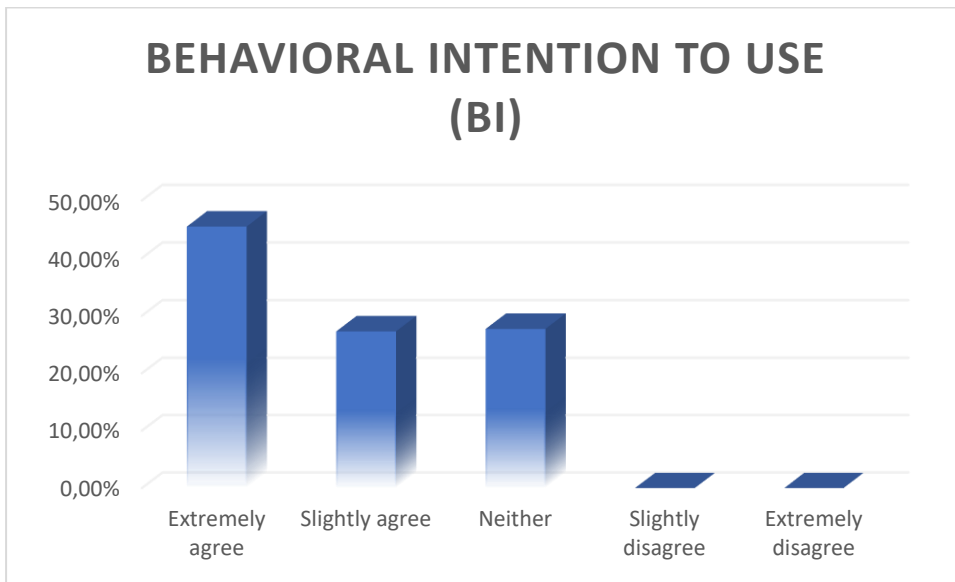
Figure 16: Graphic BI Job Scheduling-miners
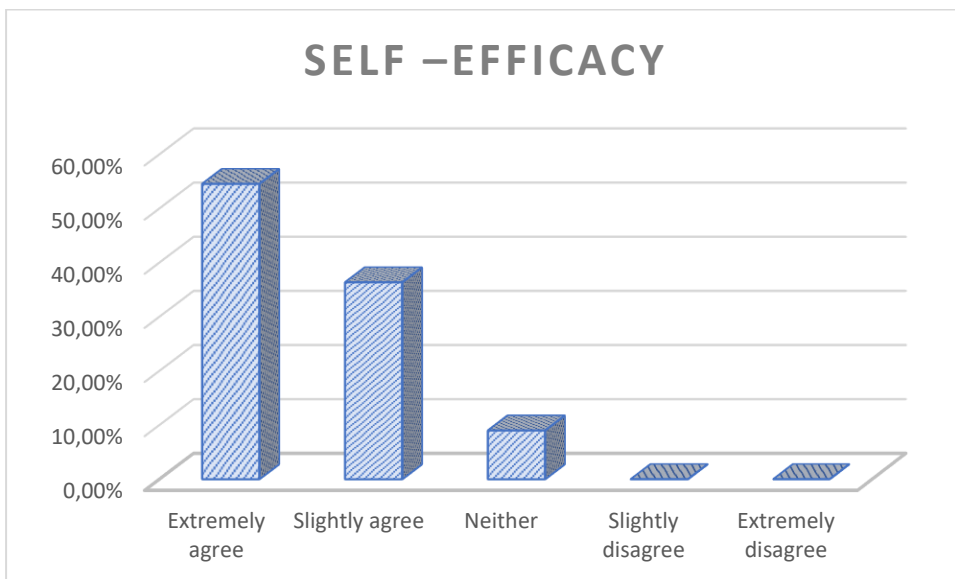
SELF –EFFICACY

Figure 17: Graphic Self-Efficacy Job Scheduling- miners

Are you aware of computerised tools for job scheduling at workplaces?

- Yes, I am. 15,2%
- I have heard about it before 51,5%
- No 33,3%

Would you think that the job scheduling tool could be useful for you and your company?

- It sounds appealing to me 69,7%
- I will definitely be engaged in such tools 15,2%
- I prefer the traditional methods of job scheduling 12,1%
- I would not like to try it 3%

You find using a computer tool for job scheduling…

- A time -effective practice 21,2%
- A cost –effective practice 3%
- A time, cost and quality of work effective practice 72,7%
- Not a good practice 3%

Results:

Regarding the perception of ease of use, here the results are not as positive as in the other tools.

While most strongly agree or agree that it will be easy to learn to use the tool and become proficient in its use, between 15% and 18% of those surveyed either do not consider themselves neutral or disagree.

This can be explained because it is a novel tool that would change the way work has been organized so far.

It would represent a substantial change and there may be reluctance to implement it, since it is easier to continue with traditional methods.

Here it is clear that the task of raising awareness, training and disseminating the tool must be emphasized.

The vast majority of participants, between 80 and 90% of the respondents, perceive that the tool is useful for the effective assignment of tasks, to improve time management, quality of work and to make the most of the skills of Workers.

Regarding the intention to use it, 70% would strongly agree or somewhat agree that they would use it if possible whereas

90% think they could use it if someone showed them how. Here we will have to make a significant effort in training and learning.

When asking more specific questions about the technology, it seems that there is no previous experience with these types of tools although they have heard of them. It is very interesting that 72,7% of those surveyed consider it an effective methodology in terms of saving time, costs and improving the quality of work.

Only 12,1% would prefer to continue with traditional methods of work organization or would not use the application (3%).

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that this data will be used by your organization in an aggregated and anonymised way, how much concerned are you about this use?	18,18%	45,45%	30%	6,06%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that that authentication and authorization will be used strictly according to the working schedule tool, how much concerned are you about your data security?	24,24%	33,3%	36,36%	6,06%

Table 14: Data on privacy and security questionnaire.

Regarding the questions about privacy and security, the level of concern about the treatment of the data seems to be low with results of between 65% -75% of the respondents who consider themselves "somewhat concerned "or "a little all". It is explained because in this tool they are not going to enter sensitive data of the workers, but data referring to days off, absences and skills of the worker.

In any case, extreme care must be taken with the treatment, avoiding leaks or failures that could harm the objectives of the Project.

3.2.3 Off-pilot group, preliminary analysis

In addition, thanks to the collaboration of the consortium members, the survey has been circulated to workers other than those employed in the pilot scenarios.

The Off-pilot surveys were launched from June 2021 to July 2021

To do this, the survey was circulated in English, with the same content as for Siemens and ANEFA workers.

A total participation of 61 users has been obtained in the surveys by CERTH.

3.2.3.1 Participants' profile:

This section is focused on the surveyed profile:

Age:
In this case, the participants who have completed the survey form a younger group than those surveyed in ANEFA. thus, only 22.5% of those surveyed are over the age of 45 years.

This is due to the fact that the average age of workers in the extractive industry has increased in recent years, which denotes a generational problem that the sector has been fighting for years. Conditions in mining are harsh and unattractive to young professionals, hence the importance of maintaining the talent of our professionals for as long as possible.
Campaigns are being carried out to improve the image of the industry and be more attractive to young professionals.

Gender:
The percentage of male and female respondents is quite similar, tilting the balance slightly towards men, with a participation percentage of 57.5%, over 42.5% of female participation.

Professional Profile:
Regarding the professional profile of the respondents, 70% of them are classified as "office workers", 2.5% are remote technical assistants, and the remaining 27.5% are classified as "other". Within this group, we find diverse categories such as scientists, researchers, computer scientists, civil servants, mechanical engineers, physicists, and data scientist.
The type of professional profile explains the younger age of the respondents and the slight trend towards greater male participation.

Years of professional experience:
If we analyse the results on the years of professional experience, the largest group, 70% of the respondents, has less than 15 years of professional experience, which is consistent with the average age of the survey participants.

Highest level of education completed:
Considering the professional profiles, when analysing the highest level of education completed, we obtain the logical result that 100% of the respondents have university or higher studies (60% have a master's degree, 12.5% a doctorate).

3.2.3.2 Data on Frequency in technology use
85% of those surveyed surf the internet daily, while 7.5% say they do it more than once a week and only 10% say they never use it or only use it once a week.

Regarding the type of applications used, the least used are health applications. 77.5% of those surveyed say that they have either never used them (32.5%), or occasionally (45%). 22.5% use them regularly (15%) or daily (7.5%).

Social networks (52.5%) and news (47.5%), which are used daily by high percentages, stand out as the most used applications on a daily basis.

Regarding meteorological applications, 52.5% use them daily or regularly, while 47.5% use them never or occasionally.

In the other applications section, those related to the stock market, banks, remote communication tools, transport tools and maps stand out.

It can be observed that it is a group of respondents with a closer relationship with new technologies and applications, which is consistent with the age of the participants and the professional profile.

Regarding the use of smartwatches or vital measurement devices, 50% of those surveyed declare to have used them sometimes or regularly, while the other 50% declare never having used them.

In relation to augmented reality devices, 90% have never used them and only 10% have ever used them.

Regarding virtual reality devices, 75% say they have never used them, while 25% say they have used them sometimes or regularly.

3.2.3.3 Data on work related well-being

WORK RELATED WELL BEING					
Aspects of the job position	Totally Unsatisfied	Unsatisfied	Neutral	Satisfied	Totally satisfied
The physical conditions of the work	2,5%	7,5%	25%	55%	10%
Hours of work per day	7,5%	12,5%	12,5%	50%	17,5%
Security at work	0%	7,5%	32,5%	40%	20%
The amount of responsibility entrusted to you.	2,5%	10%	27,5%	40%	20%

Regarding the results of well-being at work, the results are very positive. The aspect with the worst results would be the one related to the hours worked, with 20% of those surveyed declaring themselves totally dissatisfied or dissatisfied. The aspect that obtains the best results is related to the physical demands of the job. Both results are consistent with the type of profession carried out by the interviewees, with the vast majority of them working in offices.

3.2.3.4 Data on job satisfaction and job engagement

JOB SATISFACTION AND JOB ENGAGEMENT			
VIGOR			
At my work, I feel bursting with energy.	Never	Sometimes along the year	Usually along the year	Daily
	5%	27,5%	52,5%	15%
At my work I always persevere, even when things do not go well.	5%	22,5%	62,5%	15%
DEDICATION			
To me, my job is challenging.	2,5%	27,5%	57,5%	15%
My work inspires me.	0%	25%	60%	15%
ABSORPTION			
Time flies when I am working.	0%	22,5%	47,5%	30%
I feel happy when I am working intensely.	5%	32,5%	47,5%	17,5%

Regarding the level of satisfaction and commitment at work, the results are very positive in terms of both vigor and dedication and absorption. They are also similar to those obtained with respect to mining workers.

The highest percentage is obtained with respect to absorption at work, so that 77.5% feel that time flies when they work intensively on a daily basis or regularly throughout the year. This is explained in relation to the type of professional profile and tasks performed, being the tasks more mental and not physical, it is more likely that the immersion in the task is more intense in an office job than in a physical job and repetitive in the open air such as that which takes place in the extractive industry.

In addition, 65% feel happy when they work intensely, a result that is easier to obtain, also, in an office job.

3.2.3.5 Data on technology acceptance, functionalities, privacy, and security.

WORK PRODUCTIVITY TOOL THROUGH VIRTUAL REALITY/AUGMENTED REALITY & KNOWLEDGE EXCHANGE

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Learning to use the Work Productivity tool would be easy for you	50%	35%	5%	7,5%	2,5%
Your interaction with the Work Productivity tool would be easy	42,5%	45%	7,5%	2,5%	2,5%
It would be easy for you to become skilful at using this tool	50%	35%	10%	2,5%	2,5%
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Using the knowledge exchange platform would enable you to communicate better (such as by uploading videos, images, documents) with your colleagues and accomplish your work tasks better	35%	40%	20%	5%	0%
Using the knowledge exchange platform would save time in works' performance	37,5%	40%	17,5%	7,5%	0%
You would find this tool useful in your job	25%	52,5%	22,5%	2,5%	0%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If you could use this working tool to support you at work, you would appreciate working with	35%	45%	15%	5%	0%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use this tool if someone shows you how to do it first	50%	32,5%	15%	5%	0%

Table 15: Data on technology acceptance
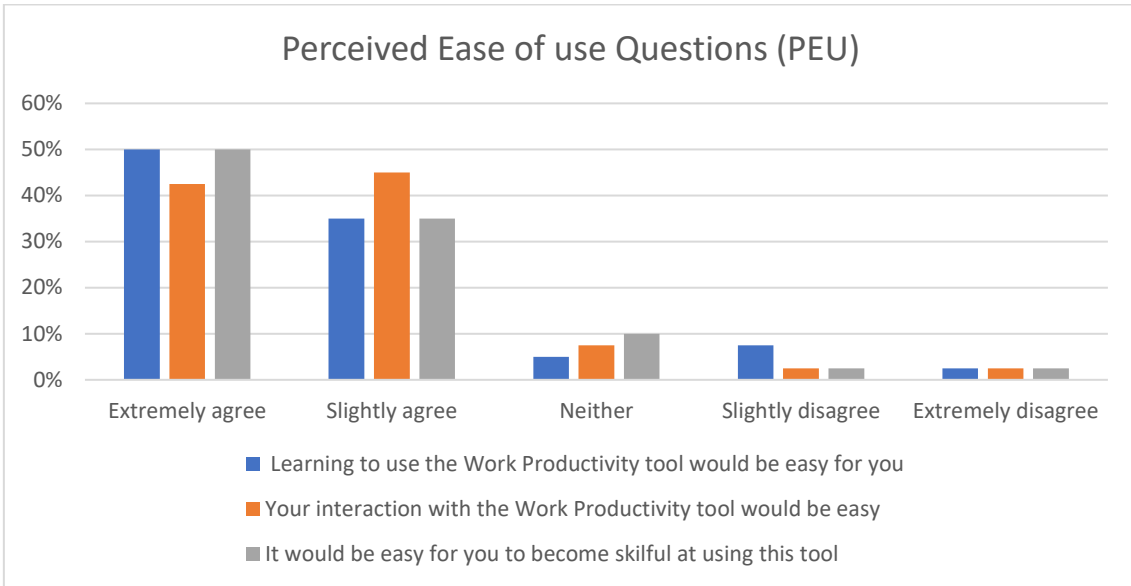
Figure 18: Graphic PEU-AV/VR off-pilot results
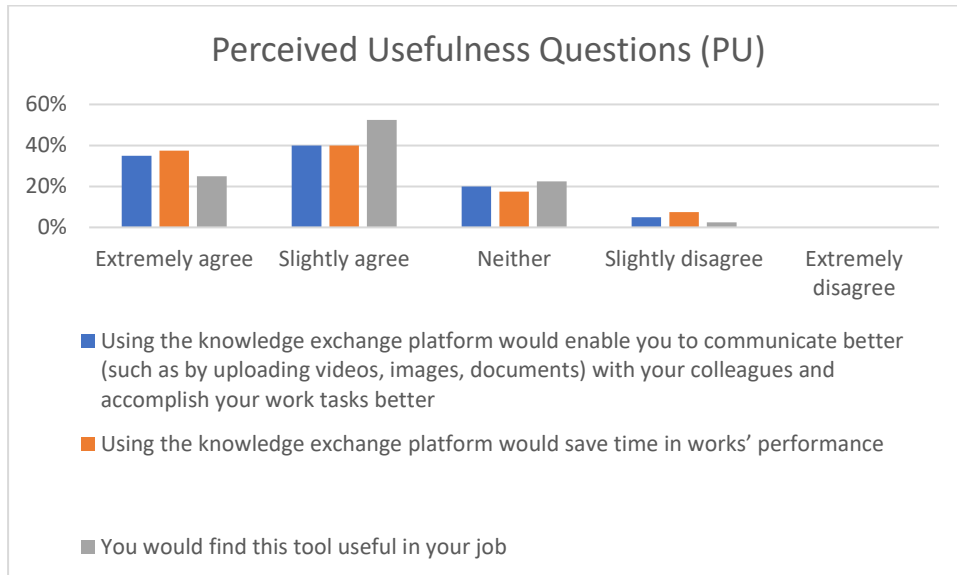
Figure 19: Graphic PU-AV/VR off-pilot results

Behavioural Intention to Use (BI)
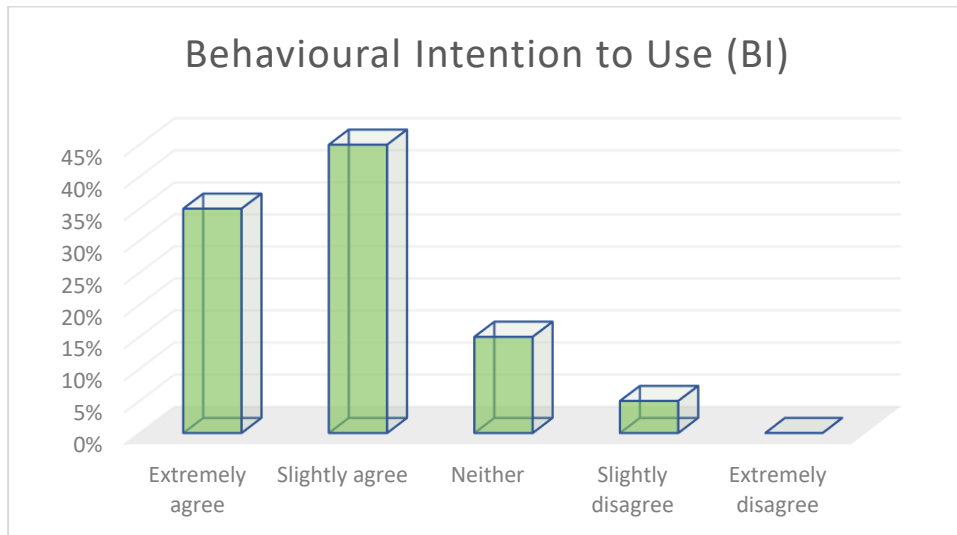
Figure 20: Graphic BI-AV/VR off-pilot results

Self –efficacy

Figure 21: Graphic Self-efficacy-AV/VR off-pilot results

Are you aware of VR/AR training tools at workplaces?
- Yes, I am. 12,5%
- I have heard about it before 30%
- No. 57,5%

You would be interested in using VR/AR as a training/learning tool?
- No 17,5%
- Yes 82,5%

Would you think that the VR/AR tools and the knowledge exchange platform could help you and your colleagues to work faster and more efficiently?
- They sound appealing to me 52,5%
- I will be engaged in such tools 30%
- I prefer the traditional training methods 15%
- I would not like to try them 2,5%

`Results:`

The results on the level of acceptance of the technology are very positive regarding the AR / VR tool and knowledge exchange platform.

Regarding the perceived ease of use, the results are very positive, with 85% of the respondents who consider that the tool will be easy to use.

The results on interaction are also very positive, with 87.5% who consider that it will be easy to interact with the tool.

In terms of becoming an expert in its use, there are also very positive results, with 85% of the respondents agreeing that it would be easy to become skilled in the use of the tool.

These very positive results may be due to a greater knowledge of the group of respondents to interact with this type of Virtual Reality and Augmented Reality tools.

Regarding the perceived usefulness, although the results are less conclusive than the previous ones, the balance continues to be very positive, with the highest number of votes in the category `**Slightly agree**´ with the statements. This may be due to the fact that, since these are questions about the specific effects that the tool can have when used in a daily work context, respondents cannot pronounce so forcefully when dealing with hypothetical results.

Regarding the intention to use it in the future, 35% of those surveyed extremely agree that they will use the tool, 45% slightly agree and only 20% consider themselves neutral or somewhat in disagreement. We can therefore conclude that the results are positive.

Regarding self-efficacy, 82.5% agree that it is necessary for someone to explain to them in advance how the tool works in order to use it. Efforts will have to be made in terms of training.

Regarding the results obtained in the more specific questions about the technology, 42.5% say they know or have previously heard of this type of tools, which is in accordance with the results obtained in the frequency of technology use. 83.5% are interested in using these tools, and only 17.5% would prefer to use traditional methods or state that they would not use the tool.

We can conclude, therefore, that there is a great acceptance of the technology by the respondents.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	Not at all concerned	A little concerned	Somewhat concerned	Very concerned
Having in mind that this data will be used by your organization in an aggregated and anonymised way, how much concerned are you about data privacy protection?	27,5%	40%	20%	12,5%

Having in mind that the information of the knowledge-sharing platform will be invisible to outsiders and /or third persons, how much concerned are you about data privacy protection?	20%	45%	22,5%	12,5%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that secure policies have been defined as part of the project to protect your privacy and confidentiality, how much concerned are you about VR and AR technologies use for?	17,5%	55%	20%	7,5%
Having in mind that authentication and authorization will be used strictly according to knowledge exchange through VR/AR, how much concerned are you about your data security? outsiders and /or third persons, how much concerned are you about data privacy protection?	17,5%	55%	17,5%	10%

Table 16: Data on privacy and security questionnaire

Regarding questions about privacy and security, the largest number of respondents consider themselves somewhat concerned about these types of measures.

Based on the profile of the respondents, they may have a greater relationship with privacy and security issues and therefore a greater concern about their safeguarding than other people who do not have this relationship and therefore cannot adequately evaluate the risks.

Important privacy and security efforts should be made to avoid system failures that could harm the privacy and security of participants.

VIRTUAL COACH & WORKER DASHBOARD

TECHNOLOGY ACCEPTANCE				
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
The virtual coaching tool was clear and easy to understand	50%	50%	0%	0%	0%
It would be easy for you to interact with the virtual coaching tool	35,7%	50%	14,28%	0%	0%
It would be easy for you to learn to use the virtual coaching tool	50%	42,8%	7,14%	0%	0%
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**

Receiving virtual coaching recommendations would provide you useful measurements for your health (for instance your cardiac rhythm)	28,5%	57,14%	0%	14,28%	0%
Using virtual coaching services such as emergency buttons would help you address effectively emergency situations at your work.	42,8%	50%	14,8%	0%	7,1%
Virtual coaching advice/recommendations during the working day would be useful as a motivation to change your health habits whenever is necessary	35,7%	50%	7,1%	7,1%	0%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If possible, you will try to use such a virtual coaching solution	14,28%	71,4%	7,1%	7,1%	0%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use the virtual coaching tool if someone shows you how to do it first	28,57%	50%	14,28%	7,1%	0%

Table 17: Data on Technology acceptance
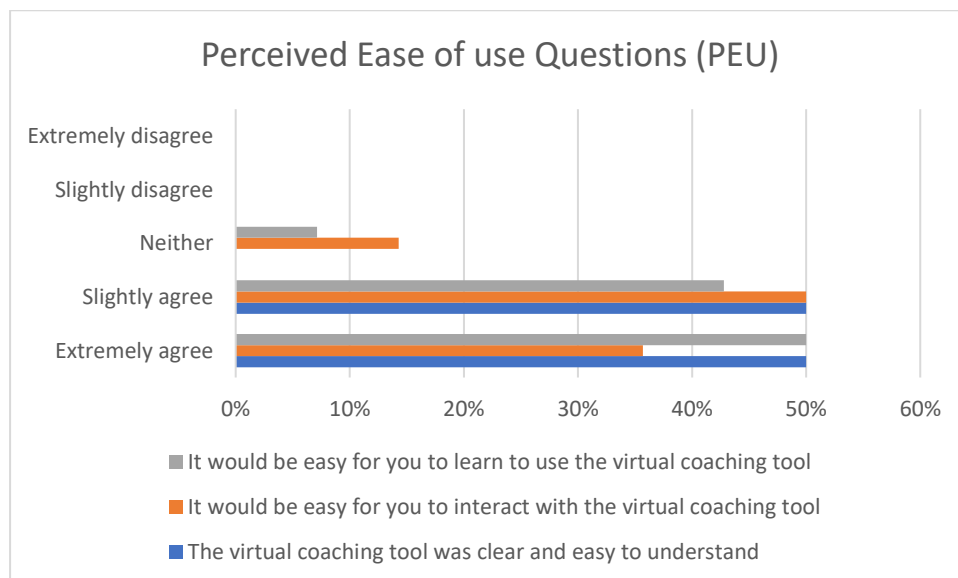
Figure 22: Graphic PEU-Virtual Coach-off-pilot results

Perceived Usefulness Questions (PU)
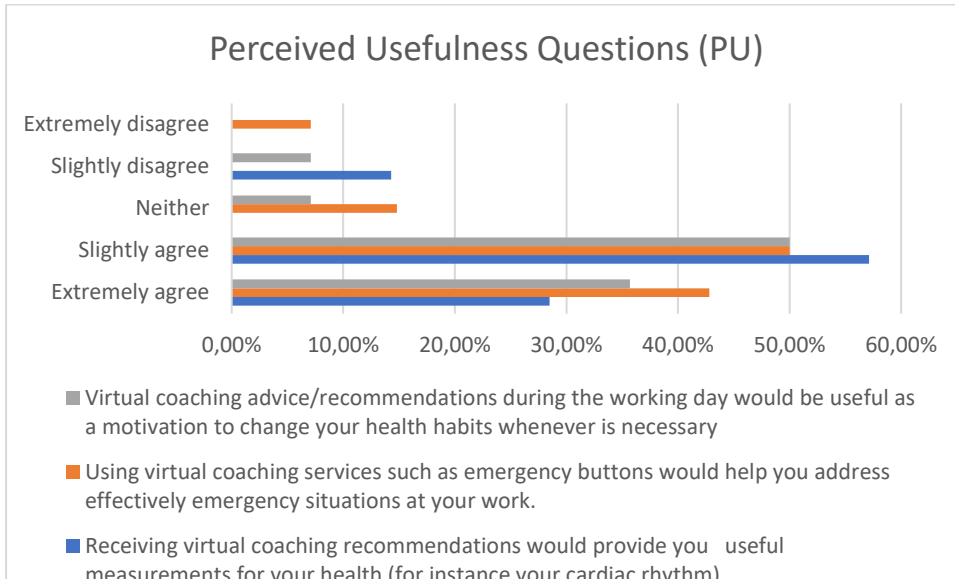
Figure 23: Graphic PU-Virtual Coach-off-pilot results

Behavioural Intention to Use (BI)
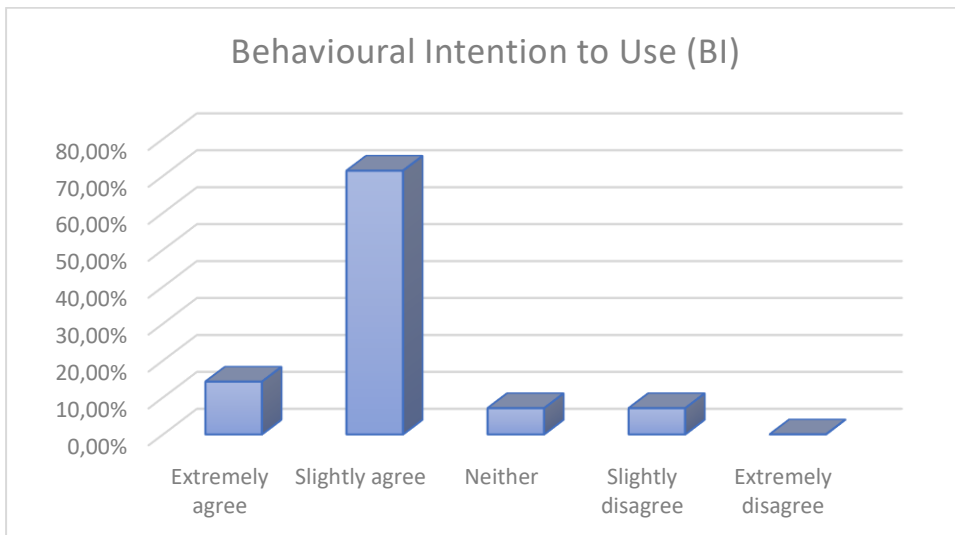
Figure 24: Graphic BI-Virtual Coach-off-pilot results

Figure 25: Graphic Self-Efficacy-Virtual Coach-off-pilot results

VIRTUAL COACHING ADDITIONAL FUNCTIONALITIES' ASSESSMENT
You would be interested in receiving advice for your health and well-being via your mobile phone/smartphone?
- Yes 85,7%
- No 14,3%

If yes how many messages would you be interested in receiving?
- Less than 1-2 messages per week 21,4%
- 1-2 messages per week 21,4%
- 3-4 messages per week 42.9%
- 1 message per day 14,3%
- 2 messages per day 0%

You would be interested to receive feedback about your daily score of achieving healthy activities also in respect to your performance the previous days/weeks
- Yes 85,7%
- No 14,3%

Would you be interested in receiving recommendations from the virtual coach about how to organize your work time? (For example, when to take a break or take a day off)
- Yes 78,6%
- No 21,4%

If yes, please explain what kind of recommendations you would like to receive
- break reminder and healthy to do suggestions during it(e.g., go for a walk, have a healthy snack)
- when to take a break
- I need it to organise and prioritize my tasks
- Mobile alert.
- when to take a day-off

Results:

Regarding the technology acceptance for the Virtual Coach and the Worker Dashboard, we can conclude that the results are very positive regarding the perceived ease of use.

It is a tool whose installation and use is simple, especially for people who, like those surveyed, may have previous experience with this type of application.

Regarding the perceived usefulness, the results are still very positive, with between 80-90% of the respondents strongly in favour or in agreement on the questions regarding usefulness. The worst results are obtained with respect to the emergency button, which is explained by its limited usefulness in office environments.

Regarding the intention to use it in the future, 71.4% somewhat agree that they would use it in the future. Although the result is positive, efforts will have to be made in communication and training to convey the usefulness of the tool and encourage its use.

Regarding the need for someone to use it previously so that the user knows how the tool works, only 50% is considered somewhat in agreement, which indicates that the tool, as it appears configured, is easy to use and may do not need as many training efforts as others.

Regarding the specific questions about the technology, 85.7% of the respondents would like to receive advice on health and well-being from the tool. Regarding the frequency of messages, the highest percentage, 42.9% would like to receive about 3 or 4 messages a week. The higher the frequency, the percentage of agreement decreases.
However, 85.7% would like to receive a summary of their daily results and 78.6% are in favour of receiving advice on how to organize their work time.

We must work to achieve a balance so that the tool is not invasive.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that only you and authorised people will have access to the virtual dashboard data, how much concerned are you about your data privacy?	21,4%	50%	14,28%	14,28%
Having in mind that this information will be processed through anonymization methods, how much concerned are you about your personal data privacy while using a virtual dashboard?	28,57%	57,14%	7,1%	7,1%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that the virtual coaching targets to provide healthy lifestyle suggestions for your overall health improvement, how much	21,4%	57,14%	0%	21,4%

concerned are you about data security?				
Having in mind that the virtual coaching provides you the potential to have an overview of your health-related data and quicker access in this data in case of emergency, how much concerned are you about the collection of this data?	28,57%	57,14%	0%	14,28%

Table 18: Data on privacy and security questionnaire

Results:

Regarding the results about privacy and security measures, although the vast majority show a slight or moderate concern about these aspects, the percentages increase with respect to the participants who feel very concerned about privacy and security issues.

The increase may be due to the fact that this application is going to manage especially sensitive data referring to the user's health and private life, which should lead to conclude that great efforts should be made in this area to avoid failures in the system that may reduce participation or perceived effectiveness of the tools.

MANAGER'S JOB SCHEDULING TOOL

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	Extremely agree	Slightly agree	Neither	Slightly disagree	Extremely disagree
Learning to operate this tool would be easy for you	33,3%	66,6%	0%	0%	0%
You would find it easy to get this technology (or tool) to do what you want it to do	0%	100%	0%	0%	0%
It would be easy for you to become skilful in the use of this tool	33,3%	66,6%	0%	0%	0%
Perceived Usefulness Questions (PU)	Extremely agree	Slightly agree	Neither	Slightly disagree	Extremely disagree
Using the information of vacations and absences provided in the Work-Scheduling tool would help you assign effectively work tasks per individual worker saving time and cost	33,3%	66,6%	0%	0%	0%
Using the Work-Scheduling tool daily notifications would be	33,3%	33,3%	33,3%	0%	0%

a good practice to support workers' daily tasks					
Using this tool, the overall time and quality of your work would be improved	33,3%	33,3%	33,3%	0%	0%
Using this tool better exploitation of workers skills would be possible	33,3%	33,3%	33,3%	0%	0%
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If you could use this tool, it to support you at your work, you would appreciate working with this	0%	100%	0%	0%	0%
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use this tool if someone shows you how to do it	25%	50%	0%	25%	0%

Table 19: Data on technology acceptance
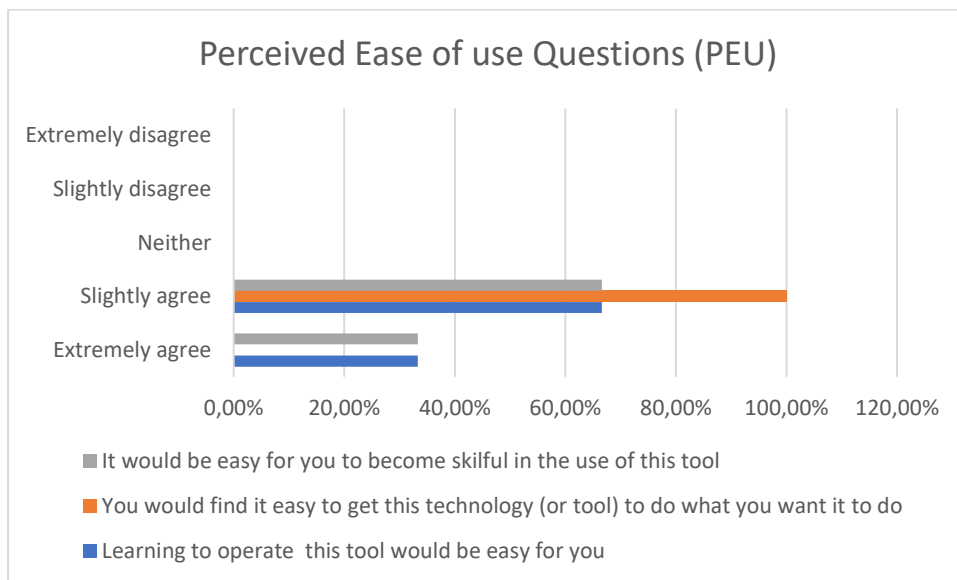
Figure 26: Graphic PEU-Job Scheduling-off-pilot results

Perceived Usefulness Questions (PU)

Legend:
- Using this tool better exploitation of workers skills would be possible
- Using this tool, the overall time and quality of your work would be improved
- Using the Work-Scheduling tool daily notifications would be a good practice to support workers' daily tasks
- Using the information of vacations and absences provided in the Work-Scheduling tool would help you assign effectively work tasks per individual worker saving time and cost

Figure 27: Graphic PU-Job Scheduling-off-pilot results

Behavioral Intention to Use (BI)
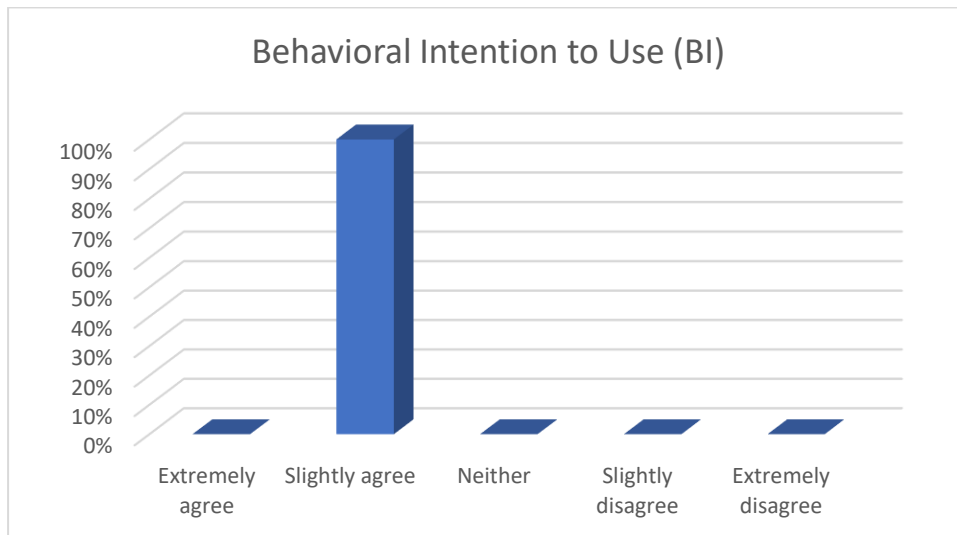
Figure 28: Graphic BI-Job Scheduling-off-pilot results

Figure 29: Graphic Self-Efficacy-Job Scheduling-off-pilot results

Are you aware of computerised tools for job scheduling at workplaces?
- Yes, I am. 66,7%
- I have heard about it before 33,3%
- No 0%

Would you think that the job scheduling tool could be useful for you and your company?
- It sounds appealing to me 100%
- I will definitely be engaged in such tools 0%
- I prefer the traditional methods of job scheduling 0%
- I would not like to try it 0%

You find using a computer tool for job scheduling…
- A time -effective practice 33,3%
- A cost –effective practice 0%
- A time, cost and quality of work effective practice 66,7%
- Not a good practice 0%

Results:

Regarding the technology acceptance in terms of work organization platforms, although the results are positive, we did not find a trend as consistent as for other tools, which may be due to the majority of respondents' employment context.

This type of tool can be more useful in other areas such as industrial or mining in which the work chain has to function without errors.

When analysing the more specific questions about the proposed technology, the results are very positive, with 100% of the respondents considering it very attractive, and a means of saving costs and improving work effectiveness.

PRIVACY AND SECURITY QUESTIONNAIRE

Privacy in general	Not at all concerned	A little concerned	Somewhat concerned	Very concerned
Having in mind that this data will be used by your organization in an aggregated and anonymised way, how much concerned are you about this use?	0%	66,7%	33,3%	10%
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that that authentication and authorization will be used strictly according to the working schedule tool, how much concerned are you about your data security?	0%	66,7%	33,3%	10%

Table 20: Data on privacy and security questionnaire.

Results

Regarding questions about privacy and security, respondents' concern about these issues is low or moderate. This may be due to the fact that particularly sensitive data will not be used in this type of tool. Even so, efforts should be made to avoid security flaws that could affect the tool and the data protection of potential users.

3.2.4 Siemens' surveys, preliminary analysis

Due to COVID-19 we had no possibility to visit a factory and conduct surveys. Therefore, we decided to conduct the survey like ANEFA online. This meant that we needed to use a mailing list to send it to related factories and office departments. This meant that we had to use a mailing list to send it to the relevant factories and office departments. This made things a more difficult as we needed the "go" from the workers' council before we were allowed to send the questionnaire to the mailing lists. The content of the questionnaire, especially the health-related part, made us additionally involve legal services before the workers' council would decide.
As we still do not have an official "go", we decided to distribute these surveys to "external users" who currently work in the home office. During the first weeks we only got 29 answers to the surveys.

As mentioned already, the CORONA crisis had a huge impact on society. However, in our case it had somehow a positive impact. The manager of the factory that was visited by the Ageing@Work project remembered the Ageing@Work AR/VR remote assistant tool and urged

the need for such tools, and also mentioned this in the management circle. Tools that allow remote people to teach the on-premises substitutes were needed immediately. We called this Home Office meets Operations.

To understand the demand and see how remote/home office can be supported we organized an internal webinar "Remote / Home Office meets Operations -> Ideas for "New Normal" work environment".

The number of potential interests was so huge that we needed to conduct 2 sessions with a total participants number of 983. During the webinar we asked the participants to participate in a small survey. With this questionnaire we reached a total response of 323 participants. Although these questionnaires had a slightly different focus there is a big overlap to the questions tried to gather in Ageing@Work. We will present these results as additional input after the survey results.

3.2.4.1 Participants' profile:

This section is focused on the profiles of the Siemens employees that were surveyed.

Age:
As mentioned above we were still waiting for the workers council, so we distributed the survey to external users, mainly working in (home) office. Doing so we reached the dedicated target group of 48 – 63.

AGE	45-53 (29 %)	54-62 (71 %)	<45 (0 %)

GENDER	Male (48%)	Female (52%)	
ACTUAL JOB			
o Office worker		68 %	
o Plant operator		12 %	
o Maintenance			
o Mobile machinery operator			
o Other		20 %	
o Remote technical assistant			
YEARS OF WORK EXPERIENCE			
0-5			
6-10			
10-15			
15-20		4 %	
20-25		40 %	
More than 25		56 %	
HIGHEST LEVEL OF EDUCATION COMPLEATED			
Primary School			
Secondary School		10 %	
University		52 %	
Masters		23 %	
Doctorate		3 %	

Vocational training	13 %
Other	

Table 21: Participants' profile in SIEMENS

Gender:
Due to the fact that we used an online format, we have a very balanced result with very slightly more female answers.

Professional profile:
As we were not allowed to interview factory workers, most of the responses came from office workers, including IT service staff, software engineers and trainers. Due to the targeted high age, the work experience of all participants was very high.

Years of professional experience:
None of the participants had less than 15 years of experiences, the majority even more than 25 years of experience.

Highest level of education completed:
78 % of the respondents had a university degree (Master, Doctorate, etc.) 13 % had a vocational training.

3.2.4.2 Data on frequency in technology use

FREQUENCY ON TECHNOLOGY USE					
With what frequency do you use the internet?	*NEVER*	*ONCE A WEEK*	*MORE THAN ONCE A WEEK*	*EVERYDAY*	
	8 %		*12 %*	*80 %*	
With what frequency do you use apps?	3		31 %	66 %	
What kind of apps do you use more frequently?	*Health apps (e.g., mobile apps)*	*Social Media (e.g., Facebook, Instagram)*	*News*	*Weather apps*	*Other*
Never	*56 %*	*56 %*	*4 %*	*8 %*	
Rarely		*28 %*	*16 %*	*8 %*	
Sometimes	*44 %*		*40 %*	*24 %*	
Daily		*16 %*	*40 %*	*60 %*	
	NEVER		*RARELY*	*USUALLY*	

Have you ever used and smartwatch or vital measurement tools?	*64 %*	*28 %*	*8 %*
Have you ever used AR tools?	*69 %*	*31 %*	
Have you ever used VR tools?	68 %	32 %	

Table 22: Data on frequency in technology use

As a summary of the questionnaire results it is very obvious, that all the participants are following the "always-connected" paradigm. This results in being connected to online collaboration and news tools via smartphones. Due to the high average age of the participants this result is surprising. However nearly 70 percent of the participants have never used any AR / VR tools.

3.2.4.3 Data on work related well-being

WORK RELATED WELL BEING					
Aspects of the job position	Totally Unsatisfied	Unsatisfied	Neutral	Satisfied	Totally satisfied
The physical conditions of the work	0%	0 %	8 %	54 %	38 %
Hours of work per day		8 %	32 %	32 %	28%
Security at work				32 %	68 %
The amount of responsibility entrusted to you.			31 %	46 %	23 %

Table 23: Data on work related well-being

Like for ANEFA results, most respondents were satisfied or even totally satisfied with aspects related to well-being at work, such as the physical conditions of the job, daily working hours, safety at work, and the level of responsibility given.

3.2.4.4 Data on job satisfaction and job engagement

JOB SATISFACTION AND JOB ENGAGEMENT				
VIGOR				
At my work, I feel bursting with energy.	Never	Sometimes along the year	Usually along the year	Daily
		16 %	64 %	20 %
At my work I always persevere, even when things do not go well.		4%	42 %	54 %
DEDICATION				
To me, my job is challenging.	25 %	42 %	25 %	8 %
My work inspires me.		27 %	50 %	23 %
ABSORPTION				
Time flies when I am working.		15 %	46 %	38 %
I feel happy when I am working intensely.		16 %	52 %	32 %

Table 24: Data on job engagement

In terms of vitality, the majority of respondents said that they usually feel energised at work all year round and that they persevere even when things are not going well. Only 8% feel that their work is challenging on a daily basis, whereas 73% said that they feel inspired by their work (23% of which even feel inspired on a daily basis). These results can certainly be explained by the high level of experience they have gained in the position and the excellent workplace and working conditions. In terms of work engagement, more than 50% feel that time usually passes when they are working and that they feel happy when they are working intensively.

3.2.4.5 Data on technology acceptance, functionalities, privacy and security

Compared to the previous surveys and in line with the Commission's recommendations, users were asked about technology acceptance for the proposed instruments. Therefore, the questionnaire contains small videos demonstrating the different tools. They were specifically asked about the perception of usefulness and ease of use, the intent to use and the self-efficiency attributed to the tool.

They were then asked specific questions about the functionalities of the tools.

Finally, we asked questions about security and privacy aspects.

The following tables analyse the results for each tool.

WORK PRODUCTIVITY TOOL THROUGH VIRTUAL REALITY/AUGMENTED REALITY & KNOWLEDGE EXCHANGE

TECHNOLOGY ACCEPTANCE

Perceived Ease of use Questions (PEU)	Extremely agree	Slightly agree	Neither	Slightly disagree	Extremely disagree
Learning to use the Work Productivity tool would be easy for you	22 %	50 %	21 %	0 %	7 %
Your interaction with the Work Productivity tool would be easy	0 %	53 %	33 %	7 %	7 %
It would be easy for you to become skilful at using this tool	14 %	21 %	57 %	7 %	0 %
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Using the knowledge exchange platform would enable you to communicate better (such as by uploading videos, images, documents) with your colleagues and accomplish your work tasks better	40 %	27 %	20 %	7 %	7 %
Using the knowledge exchange platform would save time in works' performance	36 %	50 %	7 %	0 %	7 %
You would find this tool useful in your job	43 %	43 %	7 %	0 %	7 %
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If you could use this working tool to support you at work, you would appreciate working with	14 %	57 %	21 %	0 %	7 %
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use this tool if someone shows you how to do it first	40 %	53 %	0 %	7 %	0 %

Table 25: Data on technology acceptance

Are you aware of VR/AR training tools at workplaces?
- Yes, I am. 14,3%
- I have heard about it before 50%
- No. 35,7%

You would be interested in using VR/AR as a training/learning tool?
- No 14,3%
- Yes 85,7%

Would you think that the VR/AR tools and the knowledge exchange platform could help you and your colleagues to work faster and more efficiently?

- They sound appealing to me 28,6%
- I will be engaged in such tools 50 %
- I prefer the traditional training methods 28,6%
- I would not like to try them 0%

Results:

Although the majority of those surveyed have not yet come into contact with AR / VR tools, over 85% of those surveyed can imagine working with AR / VR tools in the future. This is really astonishing and shows that the respondents can very well imagine acquiring and imparting knowledge via AR / VR tools. Many respondents also expect considerable time savings through the use of the new technologies. The respondents can imagine short training periods in dealing with the new technologies, but many are reluctant to say whether they can use the technologies skilfully.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that this data will be used by your organization in an aggregated and anonymised way, how much concerned are you about data privacy protection?	29 %	21 %	21 %%	29 %
Having in mind that the information of the knowledge-sharing platform will be invisible to outsiders and /or third persons, how much concerned are you about data privacy protection?	29 %	21 %	14 %	36 %
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that secure policies have been defined as part of the project to protect your privacy and confidentiality, how much concerned are you about VR and AR technologies use for?	21 %	43 %	21 %	14 %
Having in mind that authentication and authorization will be used strictly according to knowledge exchange through VR/AR, how much concerned are you about your data security? outsiders and /or third persons, how much concerned are you about data privacy protection?	21 %	36 %	29 %	14%

Table 26: Data on privacy and security questionnaire

Results:

Very few respondents (30 percent) are not at all concerned about data security. Most are a little to very concerned about data security. The introduction of guidelines and authentication procedures for data security changes the mood of the respondents only slightly. Most of them are still concerned about their data even after such security aspects have been introduced.

VIRTUAL COACH & WORKER DASHBOARD

TECHNOLOGY ACCEPTANCE					
Perceived Ease of use Questions (PEU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
The virtual coaching tool was clear and easy to understand	36%	64 %			
It would be easy for you to interact with the virtual coaching tool	27 %	64 %	9 %		
It would be easy for you to learn to use the virtual coaching tool	41 %	25 %	25 %	9 %	
Perceived Usefulness Questions (PU)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
Receiving virtual coaching recommendations would provide you useful measurements for your health (for instance your cardiac rhythm)	36 %	27 %	27 %	0 %	9 %
Using virtual coaching services such as emergency buttons would help you address effectively emergency situations at your work.	0 %	25 %	25 %	25 %	17 %
Virtual coaching advice/recommendations during the working day would be useful as a motivation to change your health habits whenever is necessary	27 %	27 %	18 %	18 %	9 %
Behavioural Intention to Use (BI)	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
If possible, you will try to use such a virtual coaching solution	9 %	36 %	9 %	27 %	18 %
Self –efficacy	**Extremely agree**	**Slightly agree**	**Neither**	**Slightly disagree**	**Extremely disagree**
You can use the virtual coaching tool if someone shows you how to do it first	45 %	36 %	9 %	0 %	9%

Table 27: Data on Technology acceptance

Results:

The virtual coach tool was well understood by all those questioned and, according to the assessments, can also be used easily. Advice from the virtual coach is considered useful. In

emergency situations, however, only 25 percent of those questioned can imagine trusting the virtual coach.

PRIVACY AND SECURITY QUESTIONNAIRE				
Privacy in general	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that only you and authorised people will have access to the virtual dashboard data, how much concerned are you about your data privacy?	9 %	18 %	18 %	55 %
Having in mind that this information will be processed through anonymization methods, how much concerned are you about your personal data privacy while using a virtual dashboard?	0%	27 %	27 %	45 %
Security system	**Not at all concerned**	**A little concerned**	**Somewhat concerned**	**Very concerned**
Having in mind that the virtual coaching targets to provide healthy lifestyle suggestions for your overall health improvement, how much concerned are you about data security?	9 %	18 %	18 %	55 %
Having in mind that the virtual coaching provides you the potential to have an overview of your health-related data and quicker access in this data in case of emergency, how much concerned are you about the collection of this data?	0 %	18 %	55 %	27 %

Results
Due to the nature of the data, the respondents are of course very sceptical about their health data when it comes to data security. Over 90 percent of those surveyed expressed concern about data security. Interestingly, even stricter safety measures or better, more personal suggestions by the virtual coach could not change this assessment significantly.

3.2.5 Results from the Webinar (off pilot group):

As mentioned above the apparent situation with the mandatory home-office for office employees as well as factory workers, under the previously stated circumstances, led to various challenges in the organization and management of operations. The production manager in the collaborating Siemens factory in Braunschweig, in this highly demanding situation, remembered the Ageing@Work project and the demonstration of the project outline we gave when visiting the factory in October 2019. He got in contact with the Ageing@Work colleagues at Siemens and inquired if the project had already any working solution for remote assistance since they had, due to the age structure in the factory workers, a severe lack in men-power and needed to

What devices accompany your daily work?

327 Participants say:

Smartphone	291
Tablet	73
Desktop	60
Head Mount	4
Headset	266

With regard to the main focus of the Ageing@Work project, the support of factory workers through new AR/VR tools and a better, healthier, work-life-balance in older age, 103 participants (of 200) believe, that AR-based solutions that support factory and production managers to make better and safer decisions with regard to daily operation on the work-floor are interesting and that they will become important soon.

Will AR-based solutions highly support factory and production managers to make better and safer decisions

200 Participants say:

Very important and promptly needed	26
Interesting and may become important soon	103
Interesting, but rather a long-term option	62

Other: interesting, but no use case, no use, not applicable, not interesting, not sure how this will work for applications, confused about it,

To gather also individual ideas, comments and issues we added a free text to the questionnaire. Looking at these free text answers, it looks like that the pessimistic answers rely on the fact that these participants have no clear use case in mind. Because we got answers like `Not clear on what the use case id for this´ or `at the Moment I have no application for it´.

With respect to the demonstrated VR-AR-authoring, learning and knowledge exchange solutions 44 managers expressed the need for and importance of these services and asked for details for a potential timely roll-out in their area of responsibility. A further 88 participants voiced their opinion that VR-AR-learning and knowledge exchange is a highly interesting topic and will become common use in factories very soon. Another 59 participants acknowledged the importance of VR-AR-based services in terms of learning and knowledge exchange but considered it to be a rather long-term strategy to be implemented within Siemens. Here the effort seems to play a huge role: `Too complicated for large scale applications´, `the challenge is to have 3D data of all products´ or scepticism `How flexible e.g., if the device is placed slightly different´ or `great learning tool, but will likely remain unused by 55+ generation, they prefer to feel the steel´ also the Price and the comfort of wearing VR headsets seems to be an issue: `main problem at the moment is that VR headsets are expensive and many people see them as not useful´.

What is your assessment of a VR/AR authoring & learning platform and its future use in your environment)

201 Participants say:

Very important and promptly needed	44
Interesting and may become important soon	88
Interesting, but rather a long-term option	59

Asked about the importance of VR-AR-based training solutions 77 managers consider it to be very important and beneficial in terms of efficacy compared to classical methods, for example web-based-trainings, manuals, etc. 109 participants considered it to be very interesting but did not right away see an immediate application in their field of responsibilities.

Virtual Reality for Trainings

193 Participants say:

Important	77
Interesting	109

As for the AR/VR Collaboration the result is a bit more pessimistic only 31 consider it as very important and promptly needed.

AR / VR Collaboration: What is your assessment of this solution and its future use in your environment?

172 Participants say:

Very important and promptly needed	31
Interesting and may become important soon	68
Interesting, but rather a long-term option	68

Other: Not applicable for office work, Customer Training,

Here the open comments differ a lot from `Like other VR/AR topics, there is a lot of potential but is lacking the `more than useful´`tag´ or `The delicate point is that it often needs 1 trainer for 1 trainee (unless it is recorded)´ to `How about the bandwidth?´ or `more development is needed´.

Finally, we asked how they would budget for these solutions. 97 out of 159 participants said they would not be willing to pay for such solutions, while 35 participants would pay for a licence, others suggested crowdfunding or the implementation of a proof of concept.

At the end of the webinar time was reserved for Q&A and discussion of the topic in general. One interesting remark from several factory managers was that in general Android-based applications are preferred. On request to elaborate on this point, the managers mentioned that they observed in the factory that most workers own personal or business smartphones running on Android. Thus, this is a very significant point to consider in the exploitation of Ageing@Work tools. Taking into account the general socio-economic situation of factory employees and also the company internal regulations on the provision of business smartphones this point should not be a major surprise, however, not forgotten to emphasize in the business models and exploitation plans of the Ageing@Work project.

3.2.6 Conclusions regarding ANEFA´S and `off-pilot´ results

When comparing the results obtained between the miners and the `off-pilot participants´, from the point of view of the profile of the respondent, we can conclude that although the results have been enriched thanks to a the greater female presence in the results and a greater variety of professional profiles, taking into account not only the miners themselves, but also not also those from outside the pilot, the results regarding the acceptance of the technology are similar without significant variations.

Taking into account the frequency of use of technology, both for miners and for those outside the pilot, a very close relationship with technology is observed, with the added value that this implies.

Regarding the results of well-being at work, there are large differences with respect to the percentages of workers that are totally satisfied with the level of security. While for miners more than 45% of respondents consider themselves fully satisfied, in the case of non-pilot respondents, this percentage drops to 20%.

This may be due to the fact that the mining sector is hypersensitive regarding safety measures at work as it is a risky profession. In accordance with Spanish regulations, all workers regularly receive health and safety training courses, while the authorities are very restrictive regarding the safety measures that must be applied in quarries and gravel pits in order for them to be authorized to operate.

This leads us to three interesting conclusions: first, that in the extractive industry, given that there is prior education and training regarding safety at work, if the proposed tools that might help reduce risk or improve safety for workers, they will be well received, by workers, employers and by the administration; second, that any tool that arises from the A @ W project must comply with the security measures imposed on aggregate operations; and third, that there is a market niche for non-mining or office workers, to the extent that they are not fully satisfied with the security measures in the company. Devices such as those proposed in the project may be introduced to improve this perception.

Another aspect of well-being at work in which the two groups of respondents differ the most is related to the amount of responsibility assigned. From the miners' point of view, the satisfaction or total satisfaction rates are high, with 82% of the results.

Regarding the percentages for non-miners, only 20% consider themselves fully satisfied with the level of responsibility assigned. This leads to conclude that it is in more office-type environments where, tools such as work organization that are proposed in the project could be very well received.

If we take into account the results related to job satisfaction and job engagement, another of the aspects in which the respondents differ the most is that of dedication to work. While 40% of the miners surveyed consider that their work is a daily challenge for them, only 15% of non-miners answer the same.

As for if they find their work inspiring, 29% of miners say they feel inspired on a daily basis and, instead, only 15% of non-miners answer the same.

This difference may be due to the nature of the job, to fact that more physical and manual work, such as that carried out in quarries and gravel pits, can lead to a higher level of satisfaction than other more sedentary ones.

To increase the level of user satisfaction, tools such as the Virtual Coach can be very useful, proposing exercises or healthy lifestyle habits to the worker that help them recharge their batteries and face the challenges of work with more enthusiasm. In addition, knowledge exchange and learning tools can pose a new challenge for workers, introducing new elements that inspire them in their day-to-day work.

While carrying on the interpretation of the results obtained in relation to the acceptance of the AR/VR proposed technology, if we take into account the perception of ease of use, the point where the two groups of respondents differ the most is on the ease of becoming skilful in the use of the tool (30% of miners are in extreme agreement and 50% of non-miners). This difference may be due to miner's lesser relationship with this type of technological tools. A greater training effort should be made to improve this perception.

Regarding the perception of the utility of the tool, only 35% of non-miners fully agree that the tool will help to communicate better at work, compared to 61.29% of miners.

Furthermore, only 25% of non-miners fully agree that the tool will be useful in their work compared to 37.09% of miners surveyed. These results may be due to the fact that the tool is perceived as more useful in manufacturing or industrial settings compared to other office-type settings.

Despite these fewer positive results in the non-mining environment, when directly asking respondents if they would be interested in using these tools, 82.5% answered yes (compared to 88.7% of miners).

We will have to make efforts on training to increase the perception of the usefulness of the tool. Regarding the results of intention to use it and self-efficacy, the results are very similar in both groups.

Regarding the Virtual Coach, although the overall results are very positive in both groups, the better acceptance of miners compared to non-miners is clear, in all aspects, including intention to use and self-efficacy. The trend towards greater acceptance in manufacturing or industrial environments over office environments is clear.

There seems to be a greater general concern of non-miners regarding safety and health issues when compared with the miners' results. The `off-pilot participants´ show greater general concern about security and privacy issues, which may be due to a greater awareness and experience of the participants on this matter.

The focus should be on duly informing the participants regarding the nature of the data to be used and the processing procedure to obtain informed consent from the users prior to the start of the pilots.

The `off-pilot participants´ technology acceptance regarding the Job scheduling tool is not as positive as that of the mining workers, which, as we have explained, may be due to the diverse nature of the functions or jobs to be carried out.

A training effort will have to be made to improve this parameter.

Regarding the perception of utility, the results are clearly more positive for miners compared to non-miners. Regarding the intention to use, 100% of the non-miners only somewhat agree that they would use it at work, compared to 45.45% of the miners extremely agree or somewhat agree (27.27%).

However, when asked if this type of tools would be useful for them and their companies, 100% of non-mining respondents consider that they sound appealing to them, in addition, 66.7% believe that it is a way to save time, costs and improve the quality of work, then despite the fact that their first results were not so positive, it can be concluded that there is a general acceptance of both groups regarding the work organization tool.

 All in all, we can conclude that the results in both blocks of surveys are similar and with a clear trend towards acceptance of the proposed technology.

There seems to be a greater general concern of non-miners regarding safety and health issues when compared with the miners' results. The `off-pilot participants´ show greater general concern about security and privacy issues, which may be due to a greater awareness and experience of the participants on this matter.

The focus should be on duly informing the participants regarding the nature of the data to be used and the processing procedure to obtain informed consent from the users prior to the start of the pilots.

3. 2. 7 Conclusions regarding SAG'S results

Based on the 323 webinar surveys and the 25 online surveys, all of the respondents found the AR / VR technology very interesting. But it still takes time before one can imagine the use of these new technologies in everyday life. A few selected use cases are already convincing, but many of the respondents have problems imagining the use of these new technologies in their professional domain. However, this is a common problem with the introduction of new technologies. Often the possible solutions have to be redefined on the basis of the new technologies and tools.

4. Use cases – Detailed description

4.1 USE CASE 1: Virtual Coach and Worker Dashboard

Use Case 1: Virtual Coach and Worker Dashboard	
Version	V1.0
Short Description	The Worker Dashboard is a web application that aims to empower workers and support their self-awareness about feasibility, health, and well-being through a visual representation of their data collected by the Ageing@Work system. The virtual coach motivates users to behave in ways that can improve their health and well-being. The system based on the worker's information about 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. 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. The system will include an option for interaction with the Virtual Coach, so that if a recommendation is received, the user cannot carry it out at that time, it will be communicated to the VC so that it can be sent later. The system will also include an `emergency button´ so that the user is quickly contacted and geolocated in case of emergency.
Challenges	- Provide workers with suggestions to adopt healthier habits - Early detection of the causes of insomnia and interventions to improve sleep quality - Early detection of stress and interventions to reduce it (in working and home environments). - Early communication of emergencies - Efficient self-management of relevant symptoms

	▪ Provide workers with suggestions to help them reduce the incidence of musculoskeletal problems.
Assumptions & Pre-Conditions	▪ The user must wear a smart watch on a 24/7 basis ▪ The system has information about worker's social activities and relevant family obligations/routines to the extent possible (e.g., taking grandchildren to regular evening activities; the worker must fill out questionnaires) ▪ The system has information on issues relevant to quality of sleep or stress; user provides relevant data if needed (e.g., kinds of symptoms) ▪ The system must have knowledge on exercises that can help worker musculoskeletal problems (recommendations for interventions). ▪ The system will geolocate the user and establish direct communication with the manager as soon as he presses the emergency button. ▪ Health & Safety Professionals have authored the required number and kinds of interventions to address the above issues
Goal (Successful End Condition)	▪ Advice provided to the ageing worker towards long-term improvement of health, well-being and work-life balance. ▪ Advice is provided to the user so as to help her/him with sleep problems. ▪ Intervention provided so as to help the worker to reduce her/his stress levels. ▪ The worker successfully follows the advice provided by the system (e.g., performs the proposed exercise). ▪ Worker adherence over the advice provided by the system. ▪ Quick intervention and immediate geolocation of the worker in case of emergency.
Involved Actors	▪ Worker ▪ Health & Safety Professionals (HSP)
Use Case Initiation	▪ The user registers into the application and through questionnaires updates the system with relevant information about social activity in order to be supported for a healthier lifestyle. ▪ System detects user behaviours that can be improved towards better health and well-being, increased worker stress or issues with worker's sleep quality ▪ The worker self-reports such issues (though online questionnaires) ▪ The worker uses the user's dashboard to provide information on the type and level of pain. ▪ The worker uses the user's dashboard to press the emergency button.
Main Flow	▪ The system loads the right user model ▪ The application monitors user activities and bio signals at regular intervals. ▪ If worker's heart rate or stress parameters exceed a predefined threshold, the system searches for the appropriate intervention and creates personalized notifications through the virtual coach.

D2.6	- User's daily behaviours are monitored (on work, home and on the move) and in case some advice is deemed necessary so as to help the user i.r.t. physical health or socialization, this is provided by the virtual coach - The Virtual Coach provides pieces of personalized advice related to healthy habits, exercises and correction of postures so as to help with worker's musculoskeletal issues. - According to the worker's responses to the messages (e.g., performance i.r.t the proposed exercises), the virtual coach will provide encouraging messages to the worker for successfully performing the proposed exercises, and kindly correcting him/her in case of poor performance - For long-term interventions (time-proof symptoms), the personal history of the user is considered, and long-term strategies are followed - Managers may have access only to anonymized and group-level indicators of achievements against stress or low quality of sleep (groups of 6 or more people) through the manager's dashboard
Problem addressed	- Deterioration of health and well-being along with ageing - Balancing work and personal life - Low quality of sleep - Stress (associated with work or lifestyle) - Possible accidents caused by lack of attention derived from stress and insomnia - Musculoskeletal problems and the related perceived pain - Low work performance because of relevant symptoms - Work emergencies.
Results and Benefits	- Supporting the ageing worker's health and well-being - Detection of insomnia/sleep problems and provision of tips to improve sleep quality - Detection of stress and tips to reduce symptoms and possibly causes - Improvement on productivity and workability - Reduction of accidents by changing habits - Helping the decrease in sickness absences - Improvement on security
Evaluation Criteria	- Relevant recommendations provided to worker i.r.t. to health and well-being; received with adherence - Relevant recommendations provided to reduce stress levels and improve sleep quality metrics - Degree of compliance with recommendations (the worker follows a suggested exercise). - Improved workability and quality of life - Reaction time in case of emergency communication
Relevance to Ageing@Work WPs	WP3, WP4, WP5, WP6
Privacy & Regulation restrictions	Personal and sensitive data: - not stored in cloud media - not shared with colleagues or managers

	encrypted
	• anonymized before sending achievement indicators in group-level
Environmental restrictions	None reported

Table 28: Use case 1: virtual coach and worker dashboard

4.2 USE CASE 2: AR / VR Tools & Knowledge Exchange Platform

Use Case 2: AR / VR Tools & Knowledge Exchange Platform	
Version	V1.0
Short Description	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.
Challenges	▪ Improve knowledge transfer from expert to younger employees ▪ Early Error Detection ▪ Ensure order's worker attention when needed ▪ Reduction of machinery downtime ▪ Improve knowledge sharing among employee peers ▪ Decrease the occurrences of downtimes due to absence of guidance and mentoring ▪ Increase workability of older workers and productivity ▪ Provide older workers with tools that allow more effective remote contribution to the work process
Assumptions & Pre-Conditions	▪ The system should have complete user models, information about the job positions, and tasks ▪ A knowledge base with categories of possible issues related to the above should exist, along with mechanisms facilitating searching within them. ▪ The knowledge base maintains ▪ The system should be aware of the availability of each aged worker for the AR telepresence tool. ▪ The worker must wear a smart watch during his/her shift and/or an AR display (e.g., optical see-through) is provided to the worker. ▪ The system should know the location and the model of the machinery. ▪ Machines related to his/her job position send notifications for regular check-ups.
Goal (Successful End Condition)	▪ Young worker successfully completes a search on the knowledge exchange platform. ▪ Older worker provides real-time assistance to young worker through telepresence.

	- Younger worker solves the problem or finds the right solution. - Older worker follows a training session empowered by the system's knowledge base. - The worker has completed all the tasks on machinery related to his/her job during his/her shift.
Involved Actors	- Younger Worker - Experienced Worker
Use Case Initiation	The user identifies the problem and makes some initial assumption on what he/she is looking for OR The worker starts his/her shift.
Main Flow	Knowledge exchange platform: Flow 1 (looking for relevant content in the knowledge base): - Young worker is entering key-words relevant to the operation of the machine he/she is assigned in the build-in search engine of the Knowledge Exchange Platform - The system provides search results (links to content such as explanatory pictures, step-by-step guides, videos and FAQs) - The user examines the content (articles, videos, recorded AR telepresence sessions, etc.) Flow 2 (participation in learning session) - Ageing worker needs to learn operation of a new machine that is installed in the factory; he/she has extensive experience in operation of similar machines. - Worker searches for relevant content in the built-in search engine of AGEING@WORK. - The system provides results with newly contributed material regarding the machine in question - The worker decides to attend one of the available guided VR sessions, using VR equipment. - The worker follows the interactive steps proposed by the guide, previewing required actions and receiving feedback on their own actions. - Upon successfully finishing the guide, the worker is rewarded by the reward system, which further motivates them to keep learning. In addition, relevant material is proposed by the system as next learning steps. Flow 2 (populating the knowledge base): - Experienced workers log into the Q&A platform and receive notifications of relevant questions they could contribute to - Experienced workers provide educational materials, solve questions in the Q&A platform, participate in AR Telepresence sessions to provide help and support. - Users receive personalized awards according to their activity (both young and elderly users) though the virtual coach and personalized reward system. Flow 3 (collaborative problem solving):

	- An unexpected failure in the machinery occurs during the shift of a new worker OR a young worker wants to calibrate a machine during his/her shift. - The worker seeks in the knowledge exchange database for material (documents, videos, and tutorials) related to the problem he/she is facing. - Into the database, he/she finds some documents and videos where the problem and its solution are explained. Thus he/she can follow step by step the instructions in order to solve the problem - The young worker has not found relevant information on the knowledge exchange platform for the problem he is facing and is calling a more experienced colleague for help via the AR telepresence tool. - The available colleague either from or outside his/her workplace provides guidance to young worker using the telepresence tool. VR/AR Tools: Flow 1: - During the shift, the smart watch gives the worker feedback on the current status of machines and reminds her/him of upcoming tasks that need to be fulfilled at a certain machine. - The system is informed (either automatically or by the user) that the user has finished a certain task. Flow 2: - If a machinery problem occurs, an alert is sent to the worker and gets highlighted through the smartwatch and/or some further AR display if available. If the worker does not know the solution to the problem, s/he can seek into the knowledge exchange platform or call a more experienced colleague for help using the telepresence tool.
Problem addressed	- Knowledge sharing between older and younger workers (inter-generational communication) - Reduce stress and risk resulting from multi-machinery operation - Inexperience, feeling useless, willing to change working position - Dwindling company knowledge base as older workforce retires - Production downtime due to insufficient knowledge. - Mental workload (memory, attention, fast decision making). - Psychology/Mental abilities (decrease of memory). - Reduce stress and risk resulting from multi-machinery operation.
Results and Benefits	- Creation and maintenance of worker's networks - More efficient transfer of knowledge by older experienced workers to younger workers - Older workers' knowledge remains in the company's knowledge base - Problems solved in time (real-time guidance) and with lower risk - Older workers can work and offer their expertise in more flexible ways

	▪ Reminders are helpful for remembering how to accomplish a certain subtask in case of multimachine operation (thus, it supports the decrease of memory of the elderly workers). ▪ Surveillance worker duties enhancement increases the personal perceived security, reduces stress and accidents, and supports the decrease of memory of the ageing workforce. ▪ Increased productivity. ▪ Minimized downtimes of machines.
Evaluation Criteria	▪ Worker satisfaction (the worker found information about the solution to the problem s/he was facing on the knowledge sharing platform, or recognized the guidance of a more experienced worker via the AR telepresence tool) ▪ Worker's level of readiness to move to different/secondary working positions
Relevance to Ageing@Work WPs	WP5, WP6
Privacy & Regulation restrictions	Internal restrictions (factory regulations)
Environmental restrictions	None reported

Table 29: Use Case 2: AR / VR Tools & Knowledge Exchange Platform

4.3 USE CASE 3: JOB SCHEDULING TOOL

Use 3: Job Scheduling Tool	
Version	V1.0
Short Description	The work-orchestration-tool is an essential planning tool for the factory manager. The platform is designed as a web application for managers. Different aspects of the organization are available, such as an overview of the organization's daily, weekly, and monthly tasks, an overview of the workforce and their skills. Task assignment is supported by a background DSS that helps the manager to distribute the tasks and can reschedule the tasks assigned to the workforce after a change, for example when a day off is requested. 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.
Challenges	▪ Establish an online bidirectional communication platform between the worker and the HR department to efficiently handle worker's requests ▪ Support age-friendly flexible work management (for workers) ▪ Facilitate the efficient feasibility test of the requests (for managers) ▪ Insert transparent processes in workers requests and managers decisions (request logistics) ▪ Search for and propose shift reallocations

Assumptions & Pre-Conditions	- The managers have already inserted all the required information (worker skills, shift plans, machine details, etc.) into the AGEING@WORK system. - Company personnel should be trained in the use of the platform.
Goal (Successful End Condition)	- A full lifecycle of worker's requests has been completed (the manager has approved or rejected the worker's request) - The manager has successfully scheduled the upcoming shifts using the workplace orchestration tool. - Self-management of 'days off' and 'work from home' requests (e.g., the worker is informed of the number of days still available for vacation).
Involved Actors	- Worker - Manager
Use Case Initiation	The worker is logged into the user's dashboard (mobile app) and views the schedule/calendar view, his/her personal requests history, open issues and pending requests. The manager is logged into his/her dashboard in order to schedule the upcoming shifts.
Main Flow	- Upon entering the platform, the worker is able to be informed of the number of days available for vacation, the weeks during the year to enjoy these vacations. - Upon entering the platform, the manager or the shift responsible is able to be informed of the workers available, worker's requests pending and the production needs for the upcoming shifts. - The worker initiates a request (e.g., for a day-off, or to work from home, or to be stand-by for some exceptional need). The request remains open on the dashboard (pending for approval). - The manager receives the request at the data aggregation and work orchestration tool - The manager assesses the request and makes alternative shift plans as an attempt to satisfy the worker's request (also by consuming data and models from the knowledge base) - In case of a successful shift rearrangement outcome, the manager grants the day to the worker or suggests that he/she has to change it.
Problem addressed	- Internal Communication of absences. - Production downtime due to missing knowledge. - Organization of work in the absence of workers. - Account and control of days off and work from home - Ageing worker difficulties in flexible work scheduling.
Results and Benefits	Easier handling of flexible job scheduling for the ageing worker.

	- The manager will know the absences of the workers as soon as possible. - There will be a more efficient organization of work with the employees available. - The workers will make a better self-management of their working benefits (e.g., be aware of the exact number of days off that they have left, advice the calendar, see the history of past requests, etc.). - Flexible work management for the ageing workers will be facilitated through a transparent, collaborative approach.
Evaluation Criteria	The manager is informed about the absences of the workers on time, towards a more efficient organization of the work with the employees available. In addition, the system provides the capability to support more flexible scheduling for the ageing workers
Relevance to Ageing@Work WPs	WP3, WP5
Privacy & Regulation restrictions	Worker's data related to the requests should not be shared with other workers (number of days off, reasons for applying a request and the results of the requests).
Environmental restrictions	The social environment should allow a private communication with the manager.

Table 30: Use Case 3: Job Scheduling tool.

5. CONCLUSION

Despite the enormous difficulties that the project has encountered in order to progress in accordance with the set objectives, we have managed to adapt to the unforeseen circumstances that are reflected in this deliverable D 2.6, evolution of D 2.1.

In it, in accordance with the recommendations received by the European Commission, the methodology has been modified, opting for an online route to obtain data on technology acceptance, security, privacy and data protection.

Thanks to this decision, not only an increase in user participation has been achieved, but also an enrichment of the results, with a significant increase in female participation, with responses from various professional groups, stakeholders.

The use cases have been reformulated and simplified so that the final three use cases recast the previous use case proposals in response to user requirements and the results obtained in the surveys and focus groups carried out in the pilots.

The solutions obtained in the proposed use cases will be tested in the German and Spanish pilots, in accordance with the Pilot Plan developed in D 7.2

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ANNEX

ANNEX 1: SAFETY PROTOCOL IN QUARRIES

1. COMMON GENERAL OPERATING INSTRUCTIONS

1.1 Procedure for confirmed cases in the company
- The company must develop a specific protocol in the event that a worker's contagion is confirmed.
- The company must identify the internal contacts of the affected worker.
- In addition, to inform the medical services of the company or the mutual, it must be communicated to the prevention service and the Optional Director, so that, depending on the job position occupied by the affected worker, they adopt the appropriate measures.
- It will also be communicated to the legal representation of the workers, subcontractors and freelancers who may have been in the workplace during the last 15 days.
- The work area, the equipment used, and the areas occupied by the worker will be cleaned and disinfected.

1.2 Especially sensitive workers
- According to indications of the Ministry of Health, it is the responsibility of the Prevention Services to determine which workers belong to a group especially sensitive to COVID-19 in the development of their work activity.
- A vulnerable group is considered to be any worker with previous illnesses or a pregnancy situation that may increase their susceptibility to COVID-19 infection.
- Workers who suffer from any of the causes that make them especially sensitive to COVID-19: over 60 years, chronic lung conditions (asthma, chronic bronchitis, etc.) or heart conditions, high blood pressure, diabetes, immune disorders, kidney problems or chronic liver, pregnancy or breastfeeding, under active chemotherapy or immunosuppressants, must notify the person assigned by the company for this case so that, with the utmost confidentiality, the appropriate protection measures are adopted in each case.
- The presence of the particularly sensitive worker in the workplace should be limited as far as possible through the promotion of teleworking or other flexibility measures. In case of impossibility, the vulnerable worker must be isolated at a minimum safe distance from the rest of the workers or through the use of separation screens or the use of appropriate PPE.

1.3 Travel between home and work

- Whenever possible, use the mobility options that best guarantee an interpersonal distance of approximately 1.5 meters. If the distance of 1.5 meters cannot be respected in private transport with companions, the use of a mask will be mandatory.
- The preferential use of individual transport is recommended.
- In the use of masks, the provisions of the Health Authorities will be followed. The use of masks on a regular basis is mandatory, including public transport.
- When the same private transport vehicle is shared, the provisions of the Health Authorities regarding the use of masks and the establishment of safety distances will be followed. As general guidelines, masks will be used and the maximum safety distance between the occupants will be sought.

1.4 Management of entries and exits in the work centre, access control and reception / shipment of cargo

- Measures will be adopted so that only authorized personnel access the operation, and the necessary means of information will be established (for example, posters, information notes, public address, etc.) to guarantee that all persons who access are aware of and assume the measures adopted to avoid contagion
- It is recommended that, before leaving their homes to move to their jobs, workers take their temperature and, if it exceeds 37.5 ºC, proceed as indicated in section 4.2.
- Ensure safety distances at entrances avoiding crowds, through the following measures:
    o Staggered and shift entry into work areas in order to avoid crowds.
    o In the queues for entry / exit / access to common areas, devices will be signalled and established to guarantee the minimum safety distance between people. If for reasons of space, this is not possible, employees must wear a mask.
    o Whenever possible, dedicate an entrance door and an exit door of these premises and ensure the presence of adequate cleaning means for hand washing.
    o Also, if possible, the doors will be left open to avoid the need to open them.
- Eliminate or minimize the presence of non-company personnel, taking the necessary precautions in any case.
- Specific procedures will be carried out for the access of external providers, in order to reduce contacts with the centre's staff. These procedures will include entry, exit and transit routes, as well as the procedure for loading and unloading goods (see preventive measures).
- As far as possible, transporters will be prevented from abandoning their vehicle.
- For suppliers / carriers and / or other external personnel, whenever possible, dedicated toilets will be located / installed, the use of bathrooms by company employees will be prohibited and adequate daily cleaning will be guaranteed.

1.5 Hygiene measures

- Personal hygiene measures must be reinforced in all work areas.
- The necessary material will be provided for workers to reinforce personal hygiene measures throughout the day, being able to give them, for this purpose, a personal kit (water and soap or hydroalcoholic gel, disposable tissues, etc.).
- Hand hygiene is the main measure of infection prevention and control. Workers will wash their hands frequently, for 40 to 60 seconds, cleaning them thoroughly with soap and water or hydro-alcoholic solutions:
    o If the hands are visibly clean, hand hygiene will preferably be done with alcohol-based products.
    o If they are dirty or stained with fluids, it will be done with antiseptic soap and water.

- o Only mechanical or disposable means will be used for drying hands.
- When coughing or sneezing, cover the mouth and nose with a bent elbow or a disposable tissue and immediately dispose of it in a garbage container with a lid, if possible, operated with a pedal.
- Anyone with respiratory symptoms should wash their hands frequently with soap and water, or an alcohol-based solution, because they may accidentally come into contact with secretions or surfaces contaminated with secretions.
- Touching the face, eyes, nose or mouth, with or without gloves, should be avoided, as hands facilitate transmission.
- The use of masks will be established by the prevention services based on the risk assessment or, in any case, according to what is regulated by the health authority. It is a measure to prevent the transmission of the virus that does not replace the others, so their use must be associated with guaranteeing good practices that guarantee compliance with physical distance.

1.6 Prevention measures in common spaces:
Organizational measures are aimed at maintaining the minimum safety distance between workers, and in this way, reduce the possibility of contagion. Prevention measures should be reinforced in common workspaces:

- Simple posters with visual information will be made in strategic places to remember the main prevention measures.
- A distance of at least 2 meters with the rest of the people will be kept. Speaking directly into people's faces over short distances must be avoided.
- Shaking hands or hugs will not be greeted and the aforementioned prevention distances will be kept.
- In this sense, it is suggested to try to reorder the arrangement and orientation of the workstations, the organization of the movement of people and the distribution of spaces, using furniture, partitions, shelves, corridors, etc. Jobs will be oriented so that there are no workers facing each other, whenever feasible.
- Latex or nitrile gloves (depending on allergies) must be available at all times for use, when appropriate, in places of common access, and pay special attention to their removal and disposal. In the case of using safety work gloves, depending on the risk, latex or nitrile gloves will be used underneath them. These measures will be decided by the Prevention Service, in each case.
- It will be mandatory to wash your hands with soap and water, or with an alcohol-based solution, when entering and leaving common spaces and when handling any material of common use or of several people.
- Closure, or where appropriate restriction, of the use of rest areas, dining rooms and common areas, avoiding crowds.
  - o the number of people in the closed premises will be limited and, for this, shifts and schedules will be established for the use of changing rooms, toilets, dining rooms or other similar areas, in order to maintain the established safety distances, and thus avoid workers are at a distance of less than 2 m.
  - o in the case of changing rooms, as long as, despite shifts and staggered use, a minimum separation of 2 m cannot be guaranteed, work clothes may be brought from home.
  - o Cleaning and disinfection measures for showers will be reinforced or, when this is not possible, they will be temporarily closed.
  - o Closed spaces (rooms, offices, common areas, etc.) must be ventilated for at least fifteen minutes a day.

- As far as possible, the working day will be adapted to avoid overlapping meal shifts. It will even be preferable, if possible, to carry out continuous days to avoid that workers have to eat in the premises provided for this in the farm. Note: cases of contagion have been described in the dining rooms of mining operations, by workers who prioritize socializing and relax the indicated measures.
  - Whenever possible, drink bottled water. If you use common bottle racks, you should wash your hands before and after use.
  - It is recommended to prohibit the use of water coolers that require bringing the mouth closer to the tap.
  - It is recommended to eliminate common coffee makers.
  - Cutlery, glasses, plates, etc. will not be shared.
  - Drinks or food will not be shared either.

1.7 Cleaning measures

- The general cleaning of the common use premises will be reinforced: toilets, changing rooms, dining rooms, etc., with the appropriate products for disinfection. Partitions, doors, windows, surfaces, knobs, railings and other places susceptible to contact with the hands will also be cleaned.
- One of the priorities in the disinfection of the toilets is the thorough cleaning of the toilets.
- Bleach and ammonia are two essential basic elements that act as disinfectants. Bleach is recommended for all areas such as toilets, taps, sinks, radiators and contact surfaces. Cleaning can be done with the usual detergent and disinfection with sodium hypochlorite solution (commercial bleach) with a concentration of 20-30 ml per litter of water, 62-71% ethanol, 0.5% hydrogen peroxide or other authorized virucidal products that have been shown to inactivate coronaviruses when applied for one minute
- In any case, a correct protection of the personnel in charge of cleaning must be ensured. All tasks must be performed with a single-use mask and gloves. For cleaning tasks, it is recommended to use vinyl / acrylonitrile gloves. When using latex gloves, it is recommended to use them over a cotton glove.
- Handkerchiefs, papers, gloves and other residues that could be contaminated will be removed with caution and garbage bags will be closed well.
- Periodic ventilation tasks must be carried out in the facilities and, at least, on a daily basis and for more than five minutes. Whenever possible, the different areas will be ventilated after cleaning.
- It is advisable to reinforce the cleaning of the air filters and increase the ventilation level of the air conditioning systems to renew the air more regularly.
- The operation of soap dispensers, disinfectant gel, disposable paper, etc. should be checked at least daily, proceeding to repair or replace those that are faulty. It is recommended to have a record of these actions. The operation and cleanliness of toilets and toilet taps should also be monitored.
- Waste management, in accordance with the Instruction on household waste management and COVID-19 published by MITECO:
  - All personal hygiene material - masks, latex or nitrile gloves, etc. - must be deposited in the remainder fraction (grouping of household waste that is obtained once the separate collections have been made).
  - In the event that a worker presents symptoms while he is at his job, it will be necessary to isolate the container where he has deposited tissues or other used products. This garbage bag must be extracted and placed in a second garbage bag, with closure, for its deposit in the remainder fraction.
- In the case of shift work that share equipment:

o Disinfection, whenever possible, of workstations between shifts. When disinfection of workstations is not possible, workers must have protective gloves, in accordance with the UNE-EN ISO 374.5: 2016 standard.

- o When mobile equipment is shared by several workers, **disinfection of the cabins and gripping elements at the entrances, at least once a day.** In the case of collective transport (workers' transport cars, vans, etc.), it will be disinfected, whenever possible, after each use, or at least once a day. Unless technically impossible, the company will take any suitable provision to maintain a safe distance between the driver and passengers (1 per row, seated to the right left starting from the driver.

- ▪ Prevention measures should be reinforced in the use of shared material:
  o at each shift change, the shared use material will be cleaned: tables, counters, computer screens, keyboards, mice, microwaves, screens, etc.

- ▪ After use, it will be mandatory to clean tables or designated places with the sanitary material made available.
  - Cleaning kits will be provided: disinfectant cleaner, disposable wipes and gloves.
  - As far as possible, you should avoid sharing items such as mobiles, pens or other types of personal use items.

- ▪ Whenever the cleaning of work clothes is carried out in the company, the clothes should be handled as little as possible, be gently rolled up and taken directly to the laundry or placed in a bag for transfer. Clothes must be washed at a temperature of at least 60 ° C for at least 30 minutes, or with any other method that guarantees proper sanitation.

1.8 General measures at work

- ▪ Face-to-face meetings or encounters of several people will be prohibited, where the distance of 2 m between the attendees cannot be ensured, and the capacity of the facilities is not exceeded by 50%.

- ▪ Common areas must be aired at least 15 minutes per hour of common use.

- ▪ Preference will be given to communications between operators via mobile phone, station or similar, whenever possible.
  o the stations / telephones of common use will be cleaned before leaving them in their place of load or giving them to another person.

- ▪ For the reception of any material, a separate and marked place must be established.
  - o When necessary, disinfection of loads in package form (pieces, etc.) will be carried out whenever possible. For obvious reasons, bulk loads will not be sanitized.
  - o If the material is needed immediately, it should not be removed from the established place, and it should be handled with gloves, avoiding all types of contact with the content until the packaging or box is immediately discarded along with the gloves.
  - o As an additional measure, it is advisable that, once the gloves have been removed and the content has been touched, the established hygienic measures for hand washing are applied.
  - o Points will be established for hand disinfection in the loading and unloading areas.

- ▪ In maintenance tasks related to the job, in the case of using any hand tool or other work utensils:
  - o The individualized use of tools and other work equipment is recommended, and they must be disinfected immediately after use, with the sanitary material or the bleach or ammonia solutions made available. When the use of tools or other equipment is not exclusive to a single worker, they will be disinfected between uses.

- o It will be mandatory to wash your hands with soap and water, or with an alcohol-based solution, when handling any material of common use or of several people.
- o It will be mandatory to wear protective gloves during handling, when established by the Prevention Service.
- o Special attention must be paid to the removal and manner of disposal of waste that could pose a risk of contagion.

- Use of vehicles for internal movement to the workplace. Note: cases of contagion between work have been described in the movement of workers by SUV or pick-up from the common facilities to the fronts or to the mobile machines, of mining operations. Therefore, extreme precautions should be taken in these:
  - o When the same private transport vehicle is shared, the provisions of the Health Authorities regarding the use of masks and the establishment of safety distances will be followed. As a general rule, masks will be used, the maximum safety distance between the occupants will be sought, and the vehicle will be ventilated and cleaned frequently. If necessary, several trips will be made to avoid bringing many workers together.
    - Specific measures when the minimum safety distance between personnel cannot be guaranteed.
  - o After analysing the options for shift work, sequencing or postponing it, to avoid overlapping in the same place, at distances of less than 2 meters, if it is still necessary to adopt additional collective protection measures, the installation of physical barriers will be assessed. such as partitions made of transparent materials (glass, rigid hard plastic, methacrylate, glass or, in the absence of the previous ones, flexible hard plastic -generally supplied in rolls-) so as not to obstruct the visibility of workers and resistant to breakage by impact and easy to clean and disinfect. They will have, if necessary, elements that make them easily identifiable to avoid the risk of blows or collisions.
  - o When it is not possible to apply any of the above measures, the personnel of said areas or works will be provided with the following Personal Protective Equipment:

 - Respiratory Protection: surgical mask and where required by the risk assessment of the workplace, self-filtering masks against FFP3 or FFP2 particles. Given the emergency situation, in case of supply difficulties and with the sole purpose of preventing the spread of the virus, masks may be used whose type corresponds to the indications of the health authority.
 - Protective gloves, according to the UNE-EN ISO 374.5: 2016 standard.
- Long-sleeved work clothes.
 - The correct placement of PPE is essential to avoid possible entry routes for the biological agent; It is equally important to remove it to avoid contact with contaminated areas and / or dispersal of the infectious agent.
 - Respiratory protection equipment must be removed last, after removing other components such as gloves, overalls, gowns, etc.

1.9 Prevention measures at the end of the working day
- The worker must, in this order, wash his hands thoroughly, remove the mask, work clothes and gloves.
- Work tools should be left clean for the next day.
- The vehicle must be disinfected after each use, especially handles, gear lever, steering wheel, etc., using hydroalcoholic gel or other disinfectants, in accordance with the indications of the health authority.

- Work clothes and personal protective equipment must be kept clean.
- When getting home:
  - Take off shoes and leave them near the door
  - Wash hands with soap and water
  - Separate the objects that are not needed at home (keys or wallet) and leave them in a box at the door
  - Disinfect the other objects used outside (mobile or glasses), with used disposable tissues and alcoholic solution, or soap and water.
  - Wash clothes using the washing machine using long programs, with hot water and avoiding overloading.

2 SPECIFIC JOB POST INSTRUCTIONS

2.1 Additional prevention instructions for mobile machinery operators
- Once the working day is over, the cabin and the grab points for access (ladders and doorknob) to heavy mobile machinery and vehicles must be cleaned before shift changes, with special emphasis on controls, surfaces and crystals.

2.2 Additional Prevention Instructions for Administration Personnel and Scale Operators
- An attempt will be made to organize the space so that the distance between workstations is as large as possible and, at least, 2 meters. As far as possible, it will be sought to orient the positions so that there are no workers facing each other.
- Do not share objects without cleaning them first (staplers, scissors, ...)
- Clean the copier contact points before and after use.
- Sanitary protective gloves should be used to touch commonly used surfaces.
  - In the case of not wearing them, it will be mandatory to wash your hands every time you enter the premises and touch any element of the doors or other common surfaces.
- In the case of scale operators or other cases where it is necessary to attend to third parties (for example, carriers) for the issuance of any documentation, direct contact will be avoided, and for this:
  - The installation of a bulkhead-type physical barrier is recommended to prevent direct contact. Another simple option that may be possible is to pass the documents through the window for signature abroad and return. Another alternative with a lower level of protection consists of delimiting a line on the ground that marks the safety space. However, all documentation and delivery notes will be done electronically or digitally.
  - In the case of payments, payment by card or transfer will be sought, instead of payment with cash.
  - In the case of not having a screen or options so that visitors do not access the offices, the person should be asked to wait for the document to be issued outside the office.
  - In both cases, a simple poster will be drawn up and placed in a highly visible place, outside the offices, with prevention instructions for people, stating:
    - The obligation not to form groups of people in the access and to maintain distances greater than 2 meters between them.
    - The obligation to wait to be called, to avoid the concurrence of people inside.
    - If possible, keep the door open to avoid contact with knobs.
    - In the event that they must access the interior of the offices:
    . When it is time to enter, keep a safe distance, even if there is a screen.

. If it is planned, they use gloves and / or masks, they must have been made available (organize a simple dispensary), before entering the room and maintain a safe distance.
. That they remain in the premises for the shortest possible time.
. That, once outside, they throw the gloves and the mask, if they had been used, in the bin with a lid provided for this purpose, if possible, operated with a pedal.

- o In both previous cases, the manipulation of any third-party object should be avoided, resorting to the implementation of alternative measures (for example, putting disposable pens at the disposal of the truck drivers so that they can sign the delivery note and keep the pen, etc.).
- o A wastebasket should be prepared with a lid, if possible, operated with a pedal so that disposable gloves and masks can be deposited once they have been used.

2.3 Additional prevention instructions for mill / maintenance establishment operators and other operators

- ▪ Everyone must clean their work area (table, keyboard, mouse, screens, control panel, keypads, points with which they have come into direct contact, etc.) at the beginning and end of their shift.
- ▪ The stay in the work area must be limited to one person and, if this cannot be done, the minimum safety distance of 2 m must be complied with. Some of the adjustments that could be assessed are relocation of jobs, postponing some jobs to avoid overlapping in the same space and at the same time, assigning specific hours for each activity and worker by areas of the farm.
- ▪ It will be mandatory to wash your hands every time the worker enters the premises or facilities and touch any element.

ANNEX II: User requirements definition and prioritization

Following the results obtained from the surveys, workshops and personal interviews, the present section describes the relevant user requirements identified in this scope, divided into:

- Functional requirements.
- Design requirements.
- Interaction requirements.

The overall results of the analysis of user requirements are summarized in the following tables, where each requirement is described along with its relevance and importance value relevant to its prioritization, in respect to each pilot site of the project.

User functional requirements for the Ageing@Work Solutions

Nº	Type	Requirement Description	ANEFA/ Siemens	Importance value
FR1	Emergency button	An emergency button should be placed in the workplace/cabin or at the smartwatch, to be pressed in case of accident or another emergency, so that an emergency notification is sent to the management side and the worker is instantly geolocated if possible.	ANEFA	H
FR2	Check-list platform	The platform would help the worker to do a checklist of all the security items. The results of the checklist should be uploaded and communicated to the manager or person responsible.	ANEFA	H
FR3	Security elements	The worker should be able to complete the safety element checklist before starting his/her shift using the mobile app.	ANEFA	H
FR4		The app/platform should send an instant alert to the person responsible of the security if there is a failure in any of the security elements, according to a previous list of security elements, both individual and collective, or in the machinery (for example failure in the break system). An instant dialog would be established between the user and the person in charge. The contents of the platform should be updated.	ANEFA	H
FR5		In the event of a failure in the machinery the manager or security personnel will be able to initiate an immediate communication via a mobile device to provide support.	ANEFA	H

FR6		The application should allow workers to virtually perform security checklists for training purposes (without a real machine involved) before taking the responsibility of a shift.	ANEFA SIEMENS	M M
FR7	Participatory work orchestration	An age-friendly flexible work management should be provided to the users by the system (work from home/ request day-off)	ANEFA SIEMENS	H M
FR8		The platform would help the worker to ask the manager for free days or to work from home and to keep control for the free days that s/he has not enjoy yet.	ANEFA SIEMENS	H M
FR9		The manager will be able to approve the worker's requests according to their priority and the needs of each shift work-plan.	ANEFA SIEMENS	H M
FR10		Older and experienced users should be able to report their time availability to support younger workers from distance.	ANEFA SIEMENS	H H
FR11	Support for musculoskeletal problems and healthy habits – Virtual Coach Healthy habits – Virtual Coach	The worker should be able to perform evaluation of alternative ergonomics designs (ergonomics simulator) and receive the simulation results as a proof.	ANEFA SIEMENS	M M
FR12		The app would provide the user with advice on physical exercise –related activities that s/he can perform during the working day, and also while s/he is at home.	ANEFA SIEMENS	H H
FR13		The user would be supported by the system in the form of recommendations in the smartphone/smartwatch- to develop habits that will improve his/her physical health.	ANEFA SIEMENS	H H
FR14		The user should be able to provide information to the app on the type and level of pain.	ANEFA SIEMENS	M M
FR15		The app would give the worker advice on healthy habits to improve her/his sleep quality.	ANEFA SIEMENS	H M
FR16		Worker measurements would be available through the app, so the worker would be able to get an overview of parameters relevant to her/his health status, the number of hours s/he has slept, the time dedicated to performing exercises, her/his cardiac rhythm or her/his improvement since starting to implement the advice in healthy habits.	ANEFA SIEMENS	H M
FR17		Behaviour aspects of the worker, in respect of the proposed interventions (e.g., adherence to exercise), should be monitored by the virtual agent.	ANEFA SIEMENS	M M
FR18		The virtual Coach controls the worker while doing the prescribed exercises through a web	ANEFA SIEMENS	L L

		camera and advices on changing them whenever it is necessary.		
FR19		The tool should monitor the cardiac rhythm of the user and vibrate in case that abnormal HR is detected. The vibration should be identifiable by the subject.	ANEFA SIEMENS	H L
FR20	Knowledge exchange Platform, collaboration and productivity enhancement	The platform would help the older workers to share their knowledge with the younger, uploading HD videos, images or documents or addressing the problem directly with an online chat.	ANEFA SIEMENS	H H
FR21		The worker should receive symbolic awards (or any other awards provided by the company policy) according to their personal or team performance.	ANEFA SIEMENS	H H
FR22		Less experienced workers should be able to search for solutions to specific problems using search criteria (e.g., keywords).	ANEFA SIEMENS	H H
FR23		The experienced worker through the touch screen of his/her tablet will be able to provide remote guidance to a less experienced, e.g., younger worker who is on-site, to e.g., repair a machinery.	ANEFA SIEMENS	H H
FR24		From the analysis of the AR Telepresence log files the manager will be aware of the areas/fields/sectors where the most problems occur, the level of support provided to the worker and the level of satisfaction. In addition, further information on failures or better handling of machinery may be added.	ANEFA SIEMENS	M M
FR25		The app allows the workers to remotely observe several machines and to receive notification of upcoming events from each machine.	ANEFA SIEMENS	M H

User design requirements for the Ageing@Work Solutions

Nº	Type	Requirement description	ANEFA/ Siemens	Importance value
DR1	Emergency button	The emergency button should be placed in the cabin or in the smart watch and activated by touch or with a voice command, if possible, if the worker cannot use hands.	ANEFA	H
DR2	Check-list platform	The check list for the security elements should be periodically updated. It should be sent to the manager or person responsible immediately after it is completed. The results of the security list should be uploaded to the manager´s platform profile.	ANEFA	H

DR3	Participatory work orchestration	The platform must be designed so that the user can check the days left to enjoy, the weeks or days of vacations available that have not yet been requested by colleague, and the ones that he can no longer request.	ANEFA SIEMENS	H M
DR4		As for the days of absence due to justifiable family or medical needs, the user can mark his request for days with ranges from 1 to 3, one being unchangeable and three changeable.	ANEFA SIEMENS	H H
DR5		Employees will be provided the tools to manage requests based on a digital calendar visible in the mobile app.	ANEFA SIEMENS	H H
DR6	Knowledge exchange Platform, collaboration and productivity enhancement	The platform must be designed so that high-quality videos, images, documents and other content about safety requirements or advice or tips from older workers can be shared with younger workers.	ANEFA SIEMENS	H H
DR7		The content must be updated, and the platform should divide the contents into more recent files, more visualized and better valued.	ANEFA SIEMENS	H H
DR8		The platform will include a chat session to establish instantaneous communications between the workers.	ANEFA SIEMENS	H H
DR9		Users should be guided into the necessary actions to be implemented using virtual objects projected on top of the real-world scene (sensed through the mobile device camera).	ANEFA SIEMENS	H H
DR10		The AR-based telepresence tool should provide aids that will help the user into easy overview of the overall process, previous steps etc.	ANEFA SIEMENS	H H
DR11		The younger users will be able to identify the authors of the uploaded materials, so to proceed with asking relevant questions through the platform if needed.	ANEFA SIEMENS	H H
DR12		The worker involved in a learning session will be informed by the virtual coach on the learning plan and the remaining exercises to be performed.	ANEFA SIEMENS	H H
DR13		The application for remote machines surveillance should be incorporated into the user´s smartwatch. It will include information from the user's machines (e.g., status, time2finish, …)	SIEMENS	M
DR14	Supporting health and wellbeing - Virtual Coach	The tools to measure bio signals (e.g., the cardiac rhythm) should be light, easy to use, activated by touch and worn under the clothes.	ANEFA SIEMENS	H M

DR15		The worker should be able to see information relevant to her/his health status (e.g., cardiac rhythm, quality of sleep, perceived stress level, etc.) through the mobile app.	ANEFA SIEMENS	H H
DR16		The user should have access to his/her own data recordings relevant to her/his health and behaviour (e.g., number of hours s/he has slept, the time dedicated to perform exercises, cardiac rhythm or improvement traits by following relevant advice).	ANEFA SIEMENS	H H
DR17		The virtual coach must have a human-like appearance, a pleasant voice and respond to the voice of the user. The exercises proposed by the coach should be easy to perform and aimed at helping in the condition presented by the subject (e.g., back pain, shoulder pain, leg pain.	ANEFA SIEMENS	M H
DR18		The system should provide vibration if the worker's heartbeat is abnormally high or low (e.g., brady-cardia, tachy-cardia), with a frequency of vibration identifiable for the user so that it does not confuse it with that of the machine.	ANEFA SIEMENS	H M
DR19		The tools to monitor worker bio signals (e.g., cardiac rhythm) must not compromise the security of the worker or limit her/his movements.	ANEFA SIEMENS	H M
DR20		Sleep control measurements should be taken by the user's smartwatch. It will include information on the total number of sleeping hours, sleep quality, night-time interruptions, heart rate and evolution since the beginning of the measurement.	ANEFA SIEMENS	L L

User interaction requirements for the Ageing@Work solutions

Nº	Type	Requirement description	ANEFA/ Siemens	Importance value
IR1	Emergency button	The emergency button will be activated by pressing or by voice command in case it is not possible to touch it, if ambient noise allows this.	ANEFA	H
IR2		If available to the system, the geolocation of the subject will be sent instantaneously to the responsible of security who will communicate with her/him to know the nature of the emergency.	ANEFA	H
IR3	Check-list platform	In the event of a failure in the machinery or safety equipment from	ANEFA	H

		the checklist, an immediate communication will be established via the tablet or mobile phone webcam with the security manager to try to repair the problem. If this is not possible, mechanics will be contacted.		
IR4		The results of the security checks will be sent to the profile of the manager on the platform.	ANEFA	H
IR5	Supporting health and wellbeing - Virtual Coach	The app will give health-related advice to the user preferably once a day, preferably in the morning when the subject goes to work. The advice should always be positive, encouraging the subject to continue with good habits taking into account the personal conditions of the use.	ANEFA SIEMENS	H H
IR6		The system notifications and recommendations should be provided to the user in an intuitive way, that will try to avoid attention theft.	ANEFA SIEMENS	H H
IR7		The user should be able to control the notification settings (level of intrusiveness) like the time to receive reports, the frequency of notifications, disturbance-free time zones.	ANEFA SIEMENS	H H
IR8		Workers should be able to provide their feedback about health status using online questionnaires on their own time availability.	ANEFA SIEMENS	M M
IR9		The worker will be able to see her/the measurements and will be able to receive daily summaries of the results obtained.	ANEFA SIEMENS	M M
IR10		The mirroring avatar should support both facial and body emotional expressions when communicating with the user.	ANEFA SIEMENS	H H
IR11		The user's emotional states should be reflected to the behaviour of the virtual coach and thus turn its appearance into that of an 'empathic mirroring avatar'.	ANEFA SIEMENS	H H
IR12	Participatory work orchestration	The platform to request free days or vacations will be accessible both to the manager and to those responsible for human resources, so that they can organize work in advance according to the workers available that day	ANEFA SIEMENS	H M
IR13		The application will send a notification to the person in charge in case more	ANEFA SIEMENS	H M

		worker requests a day of absence to optimize the workplace schedule.		
IR14		The managers will be supported by the system with automatically produced shifts work-plans suggestions, taking into account worker requests for day-off or work from home.	ANEFA SIEMENS	H M
IR15		The system will provide managers the ability to access the ergonomics assessment results (performed by the users, upon workers' request) and to perform their own simulation testing.	ANEFA SIEMENS	M M
IR16	Knowledge exchange platform, collaboration and productivity enhancement	The knowledge exchange platform will be accessible to both older workers and young people through private profiles with a password.	ANEFA SIEMENS	M H
IR17		Users should be able to upload videos, images, documents or advice relevant addressing a specific problem in the work process (repairing of a machine, calibration session etc.).	ANEFA SIEMENS	M H
IR18		The videos and other files uploaded by the worker can be deleted at any time by the user who uploaded it. The contents of the platform should not be distributed outside of it.	ANEFA SIEMENS	M H
IR19		The chat that will be included in the platform will allow the young user to address the user who uploaded the content privately or do a general question on the wall and wait for another user to answer it.	ANEFA SIEMENS	M H
IR20		The videos and other content may be punctuated by users, with the best rated ones appearing in the first place	ANEFA SIEMENS	M H
IR21		Distant users should be able to perform telepresence sessions in real-time with audio and share (camera) screen.	ANEFA SIEMENS	L H
IR22		Users will be able to evaluate the quality of the knowledgebase contents and search results received using a metric system (e.g., using smiling faces evaluation).	ANEFA SIEMENS	L M
IR23		Experienced users will be able to provide help by participating in a Question & Answer (Q&A) platform.	ANEFA SIEMENS	L M
IR24		Older and more experienced users should receive symbolic awards for their contribution to the Knowledge base and the Telepresence Tool,	ANEFA SIEMENS	M M

		towards supporting their motivation to contribute.		
IR25		The subject will wear the smartwatch which will notify by means of vibration when an interaction is required.	SIEMENS	H
IR26	General	The users should have access to the system's services on offer through personal smart phones, tablets, smart watches and PC devices.	ANEFA SIEMENS	H H
IR27		The subject will not have to enter more data than the physical ones referring to their gender, age, weight and height at the beginning of the use of the application.	ANEFA SIEMENS	M M

ANNEX III:

Direct link to the surveys:

[D2.6 V.1. Ageing@Work System Acceptance Studies-Work Scheduling tool](#)
[D2.6 V.1. Ageing@Work System Acceptance Studies-Virtual Reality/Augmented Reality tools and the Knowledge Exchange platform](#)
[D2.6 V.1. Ageing@Work System Acceptance Studies-Virtual Coach and Worker Dashboard](#)