



## Augmented reality applied to machinery maintenance from construction sector

WP2: Analysis of machinery for excavation works

Methodology and questionnaire for the focus group



**BZB**

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**FUNDACION  
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## 1. DESCRIPTION OF THE PROJECT

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The aim of this project is to design and apply a training system in basic machinery maintenance using a new technology called augmented reality. This system will improve the basic skills of machinery operators related with a safe maintenance of their machines and not only with their operation.

The Augmented Reality (AR) is the term to define a direct or indirect view of the physical environment in the real world, which elements combine with virtual elements in order to create a mixed reality in real time. So, it consists in a group of devices which add virtual information to real information. This is the main difference with virtual reality, because it doesn't replace physical reality, but superimposes virtual data on real world.

The second phase of the project aims for finding out which is the most appropriate machine for its implementation under Augmented Reality and which kind of first maintenance an operator can do by carrying out a FOCUS GROUP in each country and by making a documentary research.

### **WP2: Analysis of machinery for excavation works**

\*Analyze the outcomes obtained in the project "Training system for mechanical digger operators", in which one of the most important developments was maintenance training.

\*Carry out a documentary analysis about legislation and interesting documentation for the project.

\*Carry out a FOCUS GROUP in each country in which it will analyze and select the most appropriate machine for its implementation under Augmented Reality

\*Write down a report in which it will be specified the obtained outcomes, the most appropriate machine as well as its characteristics and main maintenance operations.

## 2. METHODOLOGY

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A focus group is a form of qualitative research in which a group of expert people are asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept, advertisement, idea, or packaging

Each focus group will be composed by 5 to 10 experts in the field of machinery maintenance.

The duration of the focus group will be around 2 hours.

The focus group will be managed by a moderator who will follow the next steps, taking into account the questionnaire enclosed to this document.

### STEPS

*Step 1: Overview about the project.*

*Step 2: Explanation about the aims of the focus group.*

*Step 3: Asking opened questions included in the questionnaire. Recording and moderation of the debate.*

*Step 4: Provide the questionnaire with closed questions to the experts.*

*Step 5: Collect the questionnaires, thanks and closure.*

**QUESTIONNAIRE****Opened questions for debating**

1. Which heavy machine is the most used for carrying out the excavation?
2. Which are the typical works for maintenance and services that can be made on the machine by the operator?
3. Which operations are done daily?
4. Which operations are done monthly?
5. Is there any special training for maintenance work in your country/region?
6. Which of the listed operations are particularly uneasy to fulfill?
7. Do you think that “Augmented Reality” could be useful for training operators on maintenance works?
8. Which machine do you think is the best to make a training prototype on AR?



Mini excavator



Tracked excavator



Backhoe



Wheel excavator

### Closed questions for individual answering

<b>CONTROLS</b>	<b>YES</b>	<b>NO</b>
Exhaust system		
Efficiency of the air heater of the engine's aspiration		
Losses from diesel injection system		
Tension and tear of belts		
Pulleys and bearings		
Elastic supports and engine's anchorages		
Supports and anchors of the radiant element		
Cleaning of the radiant element and of the intercooler		
Proper running of indicator lights and instrumentation		
Proper running of air conditioning		
Bolts of transmission shafts		
Proper running of bucket		
Condition of hydraulic cylinder rods		
Condition of hoses and metal pipes		
Abnormal noise of axles		
Oil leakage from hydraulic system		
Oil leakage from transmission and reductors		
Loader and bucket unit		
Tires wear and tear		
Wheels' nuts		
Tightening bolts' locks		

<b>INSPECTION REGISTRATIONS</b>	<b>YES</b>	<b>NO</b>
Cleaning of the filter element of engine vent		
Cleaning of plug and filter fuel tank		
Empty sediments from fuel tank		
Cleaning of the vent valve of hydraulic tank		
Empty sediments from reservoirs		
Cleaning of electrical poles and battery terminals		

<b>FILTERS AND LUBRICANTS:</b>	<b>YES</b>	<b>NO</b>
LAP (Lubricant Analysis Program) collection of samples from the engine		
replacement of engine oil filter		
Replacement of engine oil		
Replacement of primary fuel filter (water separator)		
Replacement secondary fuel filter		
Replacement of air primary filter		
Inspection and cleaning of secondary air filter		
Cleaning of air pre-filter and check of turbine pre-filter		
Check coolant level		
LAP sampling of hydraulic oil		
Replacement of hydraulic oil filter		
Check of hydraulic oil level		
Replacement of oil filter of the transmission		
LAP (Lubricant Analysis Program) collection of samples from transmission		
Axles' oil level check		
LAP (Lubricant Analysis Program) collection of samples from axles' oil		
Inspection and cleaning of cabin air filters		
Filters' cutting to control presence of dirt inside		

<b>LUBRICATION:</b>	<b>YES</b>	<b>NO</b>
Supports and cross pieces of drive shaft		
Greasing of loader unit		
Greasing of oscillator of front axle		
Backhoe greasing		
Greasing of rear axle support		

<b>SAFETY</b>	<b>YES</b>	<b>NO</b>
Presence of maintenance and operations' handbook		
Presence of safety signs described in the manual		
Presence of anti-slip material		
Proper working of rear-view mirrors		
Efficiency of safety belt		
Proper running of lighting devices		
Proper running of the wiper		
Presence of plaque control lock warning		
Access to safety cabin		
Proper running of auxiliary brake		
Proper running of reverse alarm		
Proper running of parking brake		