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ACRONYMS

Acronym	Meaning
API	Application Programming Interface
App	Application
BIF	BIMERR Interoperability Framework
BIMERR	BIM-based holistic tools for Energy-driven Renovation of existing Residences
BPMN	Business Process Model Notation
ETL	Extract, Transform, Load
H&S	Health & Safety
HW	Hardware
I3D	Industrial 3D services
KPI	Key Performance Indicator
MySQL	Open-source relational database management system
OS	Operating system
PWMA	Process & Workflow Modelling & Automation
px	Pixels
REST	Representational state transfer
SaaS	Software as a Service
SOA	Service Oriented Architecture
SW	Software
UI	User Interface
UX	User experience

EXECUTIVE SUMMARY

This document describes PWMA application for on-site renovation worker support, which we consider as a main tool for workers, project managers and foremen to be used on-site to manage, monitor and report the status of the tasks assigned to this group of stakeholders as part of the whole reconstruction process.

The application, as well as the workflow execution engine which is utilized to be the backend for the application are developed as part of the PWMA toolkit. The workflow modeled and verified by simulations with other tools of the PWMA toolkit is used by the workflow execution engine to orchestrate the whole reconstruction process, including the management of the on-site works via the smart glass application.

The provided application is part of a standalone toolset based on the I3D platform adjusted for the needs of BIMERR, which provides the set of tools covering the whole life cycle of the management and utilization of the know-how.

These are the main functionalities:

- Overview of the lists of tasks/work orders assigned to the user
- Accessing detailed information about the assigned work orders
- Assistance during execution of the work orders
- Integrated tool for progress reporting
- Connection to PWMA execution engine via notification system

The application allows for basic interactions with the tasks assigned to the user. It is integrated with BIMERR authentication system and connected to the notification system, which is provided as a part of the Deliverable D6.7 “Adaptive workflow management & automation tool 2”.

The functional capabilities are based on the user requirements identified in D3.1 and defined in the corresponding D6.3 “Adaptive Renovation Process & Workflow Models 2” and D6.5 “Renovation Process Simulation Tool 2”. The deliverable at hand therefore explains the technical concepts, the tool functionality of the requested features and provide the Android based application, which can be downloaded at <https://i3d.econtent.lu/bimerr/download/>.

In conclusion, D6.9 adapts the tool set to provide better on-site support for workers executing the renovation tasks, while D6.3 improves the way the renovation process management is performed in BIMERR.

1. INTRODUCTION

This chapter describes the main objectives and goals of this particular deliverable, as well as a methodology behind its development and integration. It also describes about the changes that were made since the previous deliverable.

1.1 SCOPE AND OBJECTIVES OF THE DELIVERABLE

This deliverable provides set of Features for Adaptive workflow management & automation

This deliverable corresponds with Deliverables D6.3 “Adaptive Renovation Process & Workflow Models 1” and D6.5 “Renovation Process Simulation Tool 2” and is closely connected to D6.7 “Adaptive workflow management & automation tool 2”. It provides the technological basis in order to perform on-site support for workers. This document therefore focuses on the tools that are provided to enable on-site interaction with the digital twin of the reconstruction process.

Based on the proposal and grant agreement, the target device of the provided application are smart glasses, however, it is not specified, what type of glasses. The initial plan of the consortium to utilize custom built smart glasses developed and provided by one of the former consortium partners has been canceled, so the developers of the SW tools and representatives of the end users are not involved anymore in the process of defining the requirements and designing the glasses (termination of task T5.5).

Other BIMERR applications for smart glasses, like ARIBFA (D5.9 “AI-enabled tools (hardware & software) for in-situ digital building model annotation via smart glasses 1”) are going to use HoloLens’s. This fact raises the need to support these glasses also by the application of on-site support of workers. On the other hand, the application should be prepared to situations, when other type of hardware, such as wearable tablets, smart phones or other different type of hard-hat compatible smart glasses are going to be used. This is the reason, why we have addressed as target device not only the HoloLens smart glasses selected as main wearable device for the project, but also other mobile devices and wearables which we expect, that can be usefully used by workers on-site.

The workflow execution engine based on the I3D platform is used as a back-end for PWMA on-site support application. The Execution engine was initially created as a standalone toolset to define and manage workflow templates, and to manage assignment of tasks for workers wearing smart glasses.

This deliverable introduces the PWMA on-site application for support of the workers, which is available for the project as builds for several operating systems. The prototype of the demonstrator is available to be used on smart glasses running Android OS or desktops running OS Windows or an android smart device.

The deliverable is closely connected to D6.7 “Adaptive workflow management & automation tool 2” which acts as a back-end and data source for the application described in this deliverable.

1.2 CHANGES FROM DELIVERABLE D6.8

Since D6.8, the application has considerably evolved. We introduced a notification system to communicate between worker and manager and vice versa. We also added an option for Health & Safety notifications. We added support for various BPMN elements, such as service tasks, timed tasks, delayed actions, parallel tasks, exclusive gateway forking, etc. We also included an option to change the worker or a manager of a workflow. We now allow to work on a workorder with more than one worker based on the imported BPMN lane (role) settings. We integrated receiving and setting worker’s position with a logic of the PWMA on-site support application for workers.

2. THE I3D APPROACH

This chapter describes all the relevant information about the I3D system and its components, data models, functions, and so forth.

2.1 I3D TOOLS OVERVIEW

I3D (Industrial 3D services) is a platform targeted for industrial customers for supporting workplace instructions and enhancing learning process of workers. It allows to define workflows and assign them to workers, support them with instructions and navigate them through the work process execution.

One of the main targets of the I3D system is teaching new workers to work with the defined work orders. To help them learn the process of the work, a step-by-step guide can be provided. Even without teaching, it is very useful to be able to guide the workers and control the flow of the work if necessary. This can be made possible by sharing pictures, photos, and videos of every task to a workorder log. It provides an on-site help from the side of a site manager and reduces an adaptation phase of a fresh worker.

The I3D Viewer has been created with a thought of being mainly used on VR/AR smart glasses, allowing workers to see the workplace in an enhanced reality. The workorder's creator can add guides to a specific task, in a form of pictures of the specific apparatus, voice navigation, or a tutorial video. All this is focused to deliver a clear work assignment.

I3D frontend manager web application allows users to define workflows and assign them to workers. Manager can also control the state of work, generate reports, and enhance workflows.

With an extension of the I3D system to suite the BIMERR PWMA conditions, we added several changes and improvements:

- an option to create workorders from BPMN files either by manually uploading them, or by sending them using a REST service
- switch from linear workflows to non-linear ones with standard BPMN elements as conditions, parallel task and other features
- an option to have multiple workers assigned to workorders, working on separate lines of work

- a standalone Notification System with an option to be used by other components

In the BIMERR integration, we omitted 3D panoramas (although it is still possible to use them) and focused for tasks managing and tasks details. We also added many features to tasks, such as attributes, sub-workorders, Health & Safety issues, and others.

For online documentation of the I3D system, head to <https://i3d.econtent.lu/dokuwiki/>.

2.2 THE METHODOLOGY AND TAXONOMY

The application for on-site work support is part of the PWMA toolkit (Figure 1), which is intended to be used as the main orchestrator of the reconstruction process. The reconstruction process is designed by the tools of the PWMA as a workflow and exported in form of BPMN to the workflow execution component. The workflow execution component creates and maintains the Digital twin of the renovation process, including keeping it up-to date to reflect the actual status of the reconstruction process. Where needed, the workflow execution component is used to exchange data with other components outside the PWMA via BIMERR Interoperability Framework (BIF). The workflow execution component orchestrates the mobile application for residents and the app for on-site work support and provides workflow related information to different BIMERR components, including the PWMA Monitoring and evaluation tool.

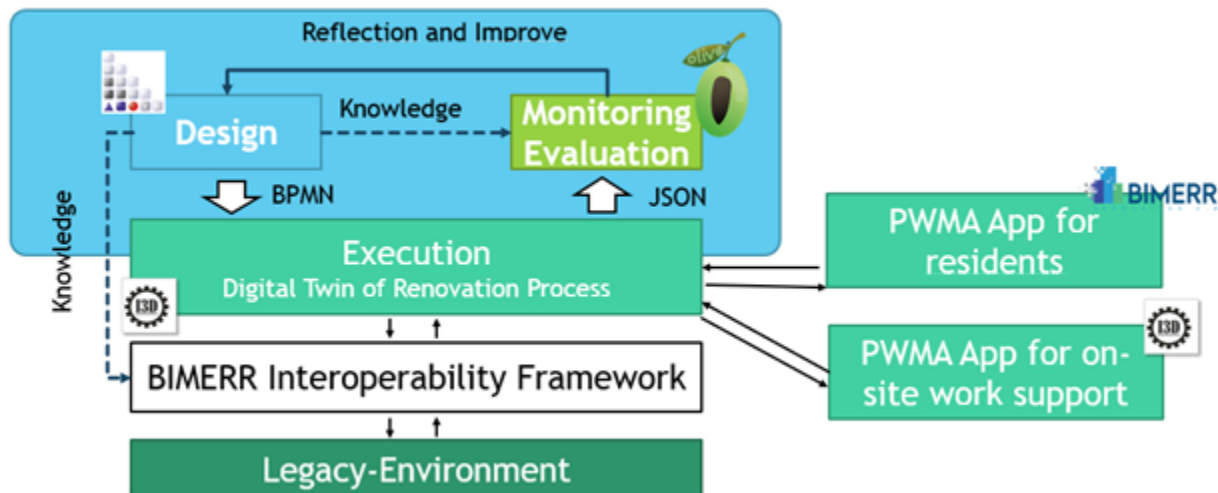


Figure 1 PWMA service overview

The App for on-site work support and the workflow execution component are based on I3D. The already existing I3D solution is an integrated platform of tools and services to support the whole life cycle of the know-how of a plant or company, from definition of process templates, over issuing task based on the defined templates to execution and reporting. This I3D system is used and adjusted accordingly the BIMERR needs to provide the functionality of executing the workflow and on-site guidance of workers. The basic principles of the I3D system remains, which are:

- Services to define and manage the templates of work processes. This has been extended with functionality to import work processes in form of BPMN file, which has been defined in external systems.
- Services to issue executable work processes based on the templates. Once the process template is defined, it can be used to generate running instances.
- Execution of the work process in semi-automatic way with the options to do user-interactions with the running work process.
- Reports about the work done, including all the data created and collected during the workflow execution.

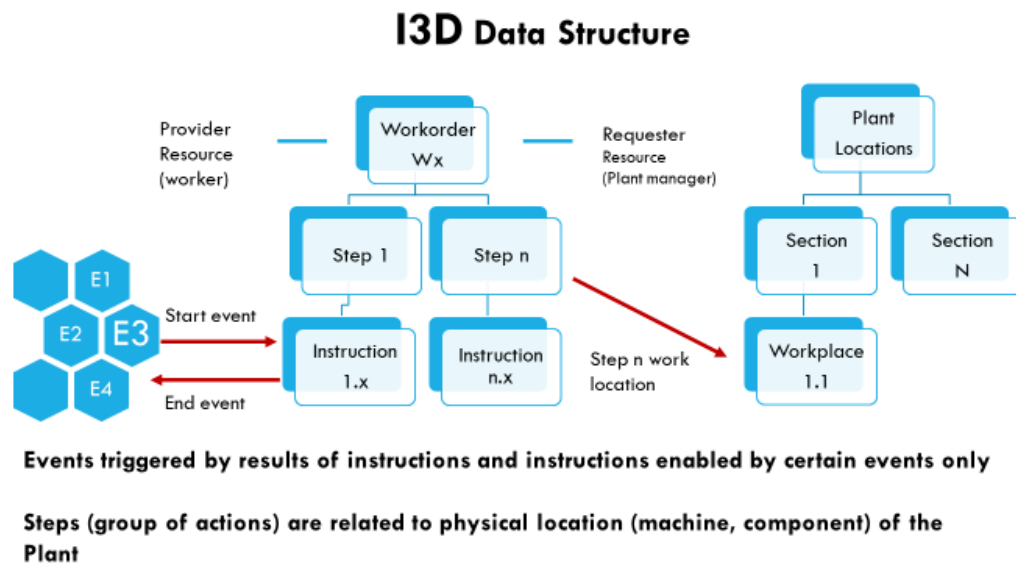


Figure 2 I3D Data structure

The data structure of I3D is displayed on Figure 2. The structure of a work process template (workflow) as well as its executable instance (work order) consists of a set of steps. Every step consists of several instructions (actions). Steps are connected to a workplace. The predefined way of execution of a work process is a sequential execution of every instruction, step-by-step. This sequence can be adjusted with events and preconditions, which are used to skip the execution of any of the actions or to terminate the execution of the work. Since implementing BPMN diagram driven work processes we implemented non-linear, non-sequential task processing. The taxonomy with more details is described in Chapter 2.4.

2.3 I3D ARCHITECTURE

The I3D has been created in accordance with the principles of Service-oriented architecture (SOA). The main building blocks are the (1) MySQL based database, which contains application data. Data of every installation is stored separately; (2) REST API webservice, which is the interface between the database and the tools working with data; (3) ETL tool, which is responsible for importing data from third party systems, including the BPMN file used in BIMERR PWMA toolkit; (4) Web based UI to manage and use the platform; (5) mobile application for on-site support of works, to be used on smart-glasses, mobile phones and tablets.

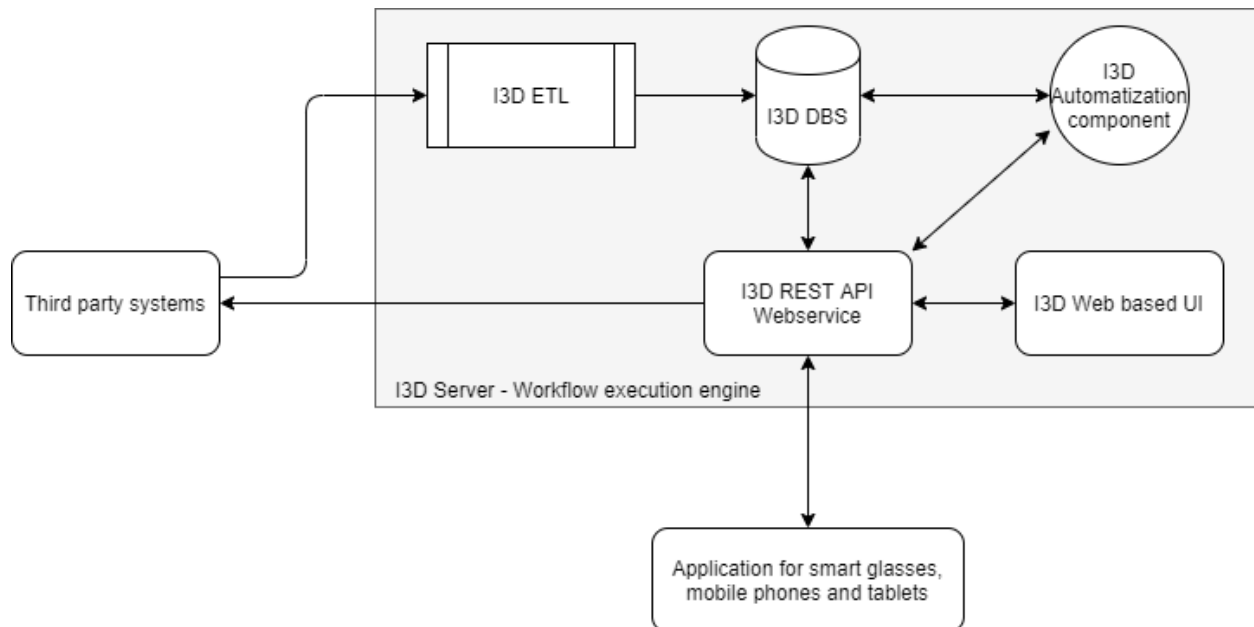


Figure 3 Architecture of I3D

2.4 DEVELOPMENT ENVIRONMENT

The main I3D components displayed on Figure 3 can be divided to 3 categories, which are developed in three main different development environments to provide three type of components – executable application, web-based application, and server-side application.

2.4.1 Mobile application

The mobile application is developed in Unity3D engine [9]. This environment has been selected because of its wide support of target operating systems, which allows to maintain only one version of the code for several type of HW. The Unity3D engine already provides support for most of the smart glasses already available on the market. Since Unity3D is widely used, also support for glasses to be launched on the market in the future is highly expected. The code itself is written in C# programming language.

2.4.2 Back-end, webservice and web-based UI

The back-end including the webservice has been developed in PHP. The web-based UI is based on Angular which combines TypeScript, HTML and CSS with the support of Bootstrap to provide modern responsible UI.

2.4.3 ETL and Automatization component

The ETL tool has been developed in JAVA programming language. It is a server-side application, which is responsible for (1) collecting data from different sources, (2) their transformation to the structure required by the I3D Data structure and Webservice and (3) loading the data to the database.

2.4.4 Push notification application and API

Push notifications consist of REST API services and Angular web application. REST API is responsible for communication between PWMA on-site support app for workers, managers and so. Notifications are implemented in PWMA Execution Engine and PWMA on-site app. Angular web application for notifications is responsible for managing user-groups, notification-groups and subscriptions.

2.5 THE I3D METHODOLOGY AND TAXONOMY

Since the workflow execution engine and its different UIs (web-based UI and applications) are based on an existing established complex solution with its own naming which is not always aligned with the naming used in the BIMERR project, it is important to define some key components (workflow, work order, step, action) for better understanding. This subchapter defines the most important components of I3D with examples in form of UI screenshots.

The I3D system contains the following elementary data types:

- Workflow – a step-by-step definition of a work process
- Step – part of a workflow linked to a specific location
- Action – a specific work instruction listed under a work step
- Event – evaluation of the previous action result
- Precondition – a rule needed to be fulfilled before an action
- Resource – a real-life material object needed to be used in an action
- Location – a specific place in space, where a step and/or an action occurs
- Hotspot – a real-life representation of an object-of interest in the virtual space
- Work order – a virtual instance of a specific work process
- Provider – user of the system and/or a work order

More information about those data types can be found in document D6.7 “Adaptive workflow management & automation tool 2”.

3. DESCRIPTION OF THE APPLICATION FOR ON-SITE SUPPORT OF THE WORKERS

This chapter contains a detailed view on the main features of the PWMA application for on-site support of the workers. Some overlapping with the Deliverable D6.7 “Adaptive workflow management & automation tool 2” is obvious, since the two components are complementary to each other, and the application is de facto an additional UI to the Workflow execution engine focusing on different user groups.

3.1 SUPPORTED HARDWARE

The smart glasses application for on-site support of the workers has been developed in Unity3D engine [9], which provides out-of-the-box support for most of the smart glasses already available on the market as well as smart glasses to be launched on the market in the future. The development tool Unity3D has been selected to support as many target devices as possible. This approach allows us to focus more on the features of the SW solution regardless the target OS, on which the application will be used. With little extra effort in the UX design, the support for mobile phones and tablets can be easily achieved, too.

Despite of the HW independency of the SW solution, it is good to have a preferred HW, on which all the functionalities are tested and fine-tuned. For this purpose, we have selected the smart wearable tablet HMT-1 [10], which is a powerful, fully rugged Android computer that is worn on the head and replaces the touch screen with an articulated micro-display, giving the appearance of a 7-inch tablet screen. On top of it, the application is tuned to utilize the built-in voice recognition feature, which gives the user the opportunity to operate the application and device fully hands-free only by voice commands. Additional features such as hard-hat compatibility, rugged drop and waterproof design and outdoor display makes it a very suitable candidate to be used on construction sites. The selected wearable allows the worker to maintain full situational awareness and maximum productivity.

Besides the preferred device, on which the application is fine-tuned, during the project, the application will be ported to several smart glasses including the MS HoloLens2 [11] as well as the support for use on mobile phones and tablets will be tuned. This will give the opportunity for the end users to select for every task or type of work the appropriate HW device.

3.2 KEY FEATURES OF THE APPLICATION

The features of the application reflect the user requirements defined in D3.1. The application is designed to support the on-site works of different user groups. The application reflects these main group of requirements:

- Exchange information between different stakeholders (Project Manager, Site Manager, Workers, Occupants, Workers)
- Generate and receive notifications
- Display the list of tasks assigned to the logged-in user
- On-site guidance of workers for critical tasks
- Documentation of the provided work
- Documentation of issues with multimedia

3.2.1 User management and related functions, customization

The first screen is the login window, which asks the user to log in with his assigned username and password (Figure 9). At the first use, the user is asked also to enter the Company name, which is the unique identifier of the installation in the system I3D. Once the identifier is entered, the application remembers and preloads it until the application is re-installed or the configuration file is deleted.

After successful authentication, the user is logged in to the application and a set of permissions to access the applications functionalities is granted to the user, based on the groups to which the user belongs. All user groups use the same application, the role of the user determines the tools, which are available for the user.

To avoid unauthorized access to information, the application has an idle counter of 10 minutes, after which the application locks the screen and the user is requested to re-login to further use of the application. The user can lock the screen or to log out from the application intentionally, too (Figure 10).

Authentication credentials that are used from BIMERR common Identity provider are more widely described in D6.7.

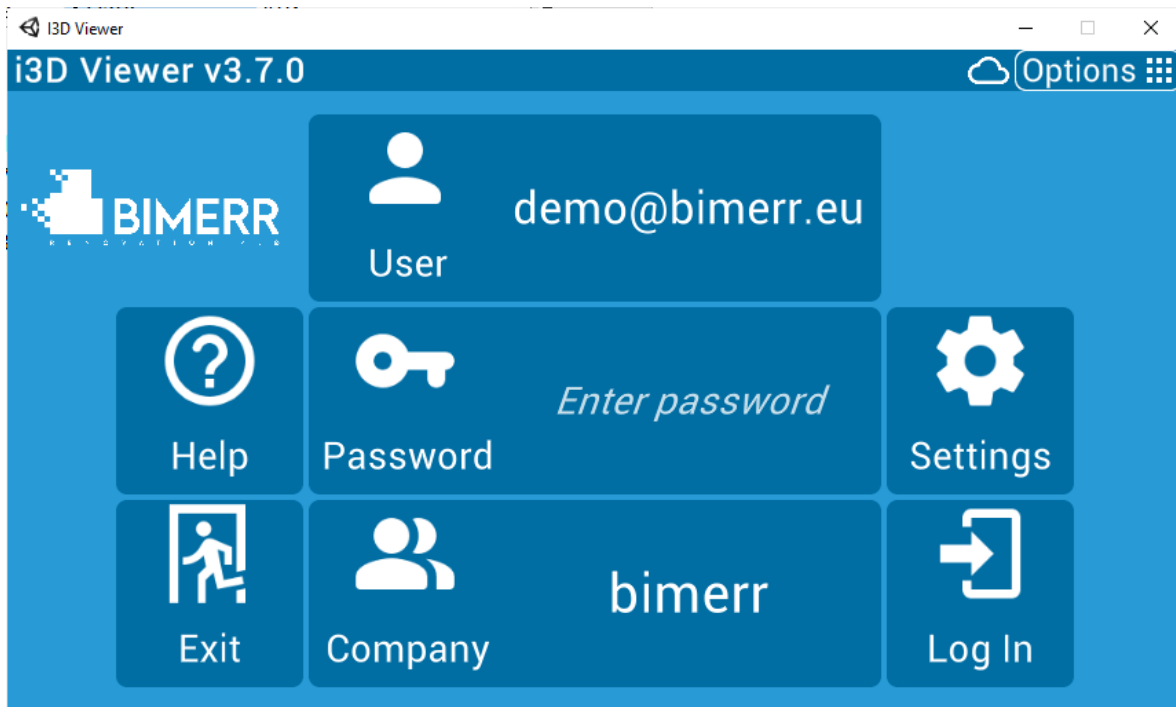


Figure 4 Log-in screen

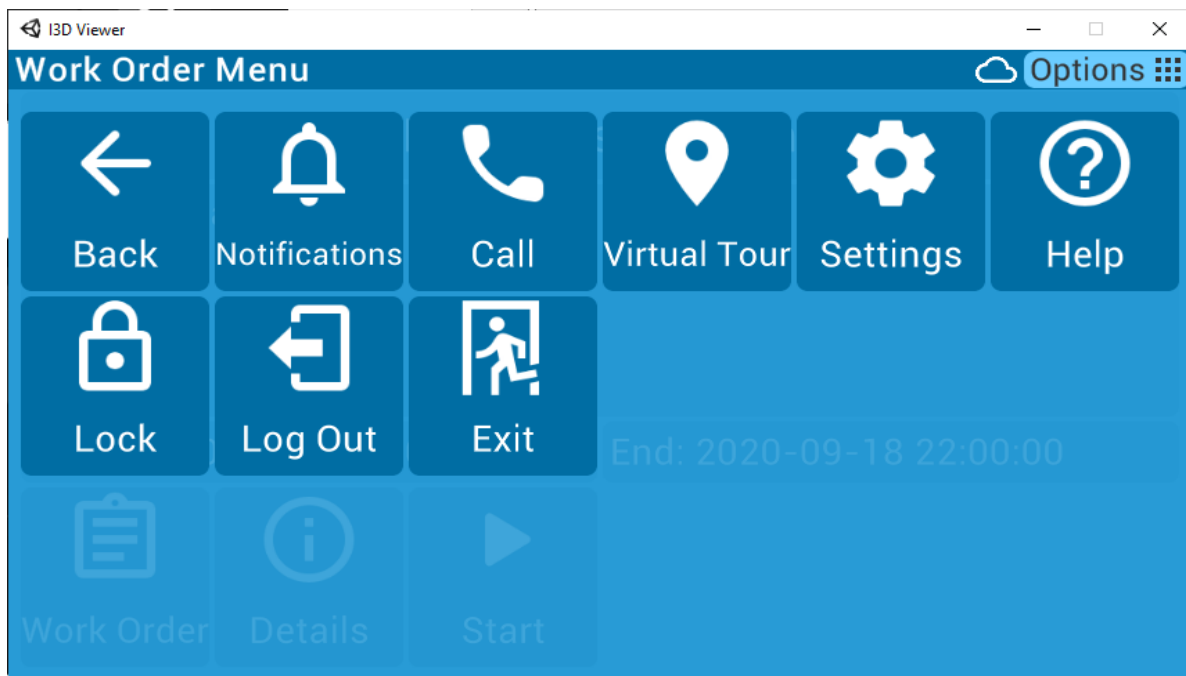


Figure 5 Options/ log out

3.2.2 User-customization options

The application is prepared to be adjusted to the needs of the user (Figure 11). The user can switch the language of the application. To support operation on different HW, the user can adjust the sensitivity of the gyroscope which makes available to control the application with head gestures. Gyroscope control is an alternative to the voice control on devices, on which the voice control is available in a limited version or is not available at all.

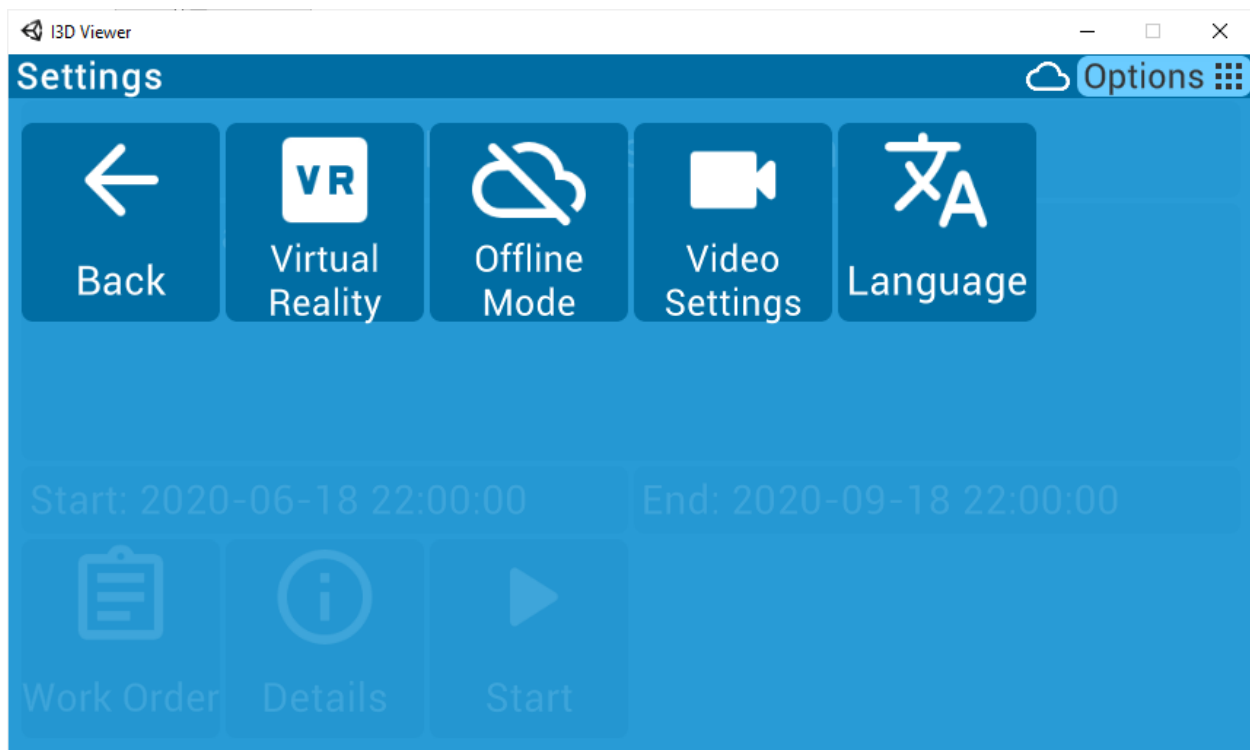


Figure 6 Settings

3.2.3 Overview of assigned Work orders – list of tasks

After successful authentication, the list of tasks assigned to the logged in user is displayed. The whole list of assigned tasks is displayed, ordered by the expected date and time of execution (Figure 12).

When the work order is assigned to a particular physical space while the worker is on another space, the work order is not listed in the respective worker’s menu. When no space is defined for the work order, it is always shown in everyone’s menu, as it’s considered to be a universal work order linked to the whole building or project.

Via this list, the worker gets always an overview about the tasks to be done. The user can check the details of any of the assigned tasks (Figure 13) and start the execution of any of the work orders (Figure 14).

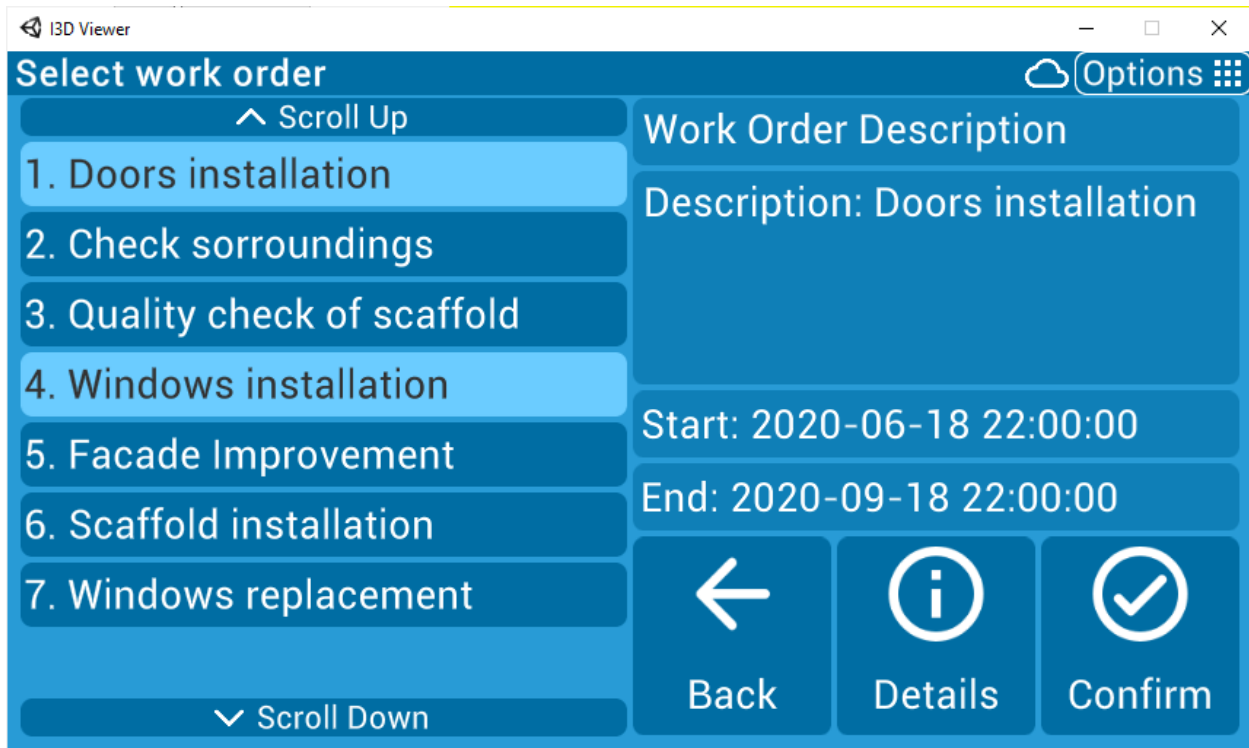


Figure 7 List of assigned tasks

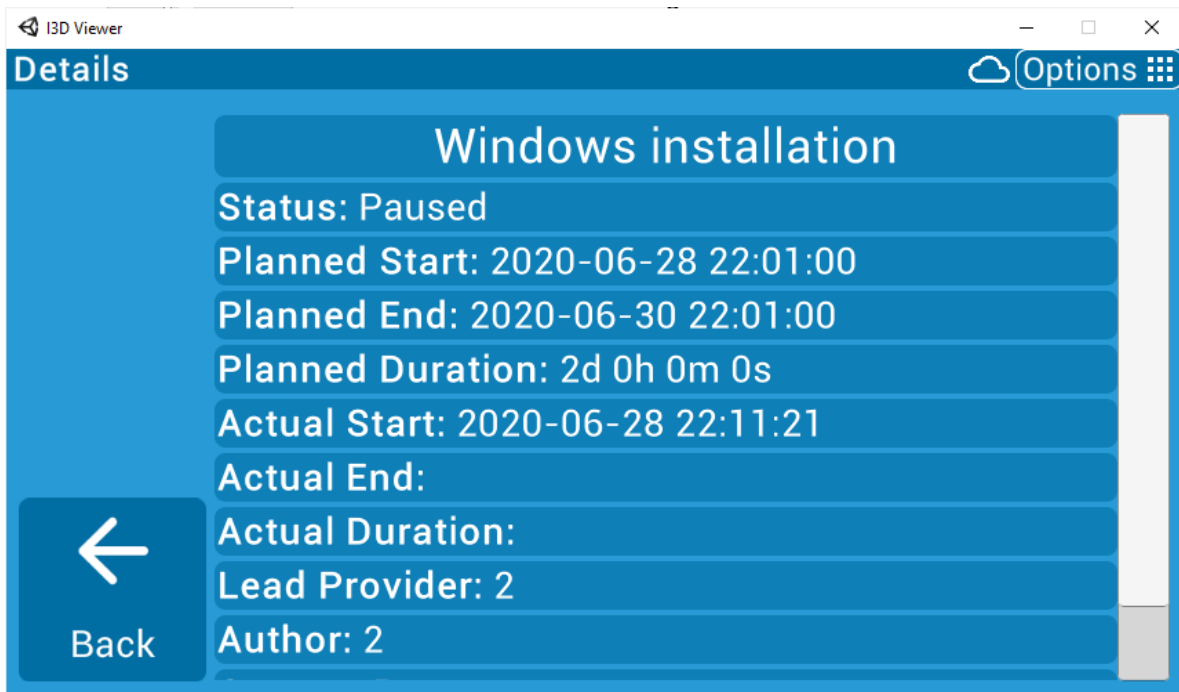


Figure 8 Details of and assigned work (work order)

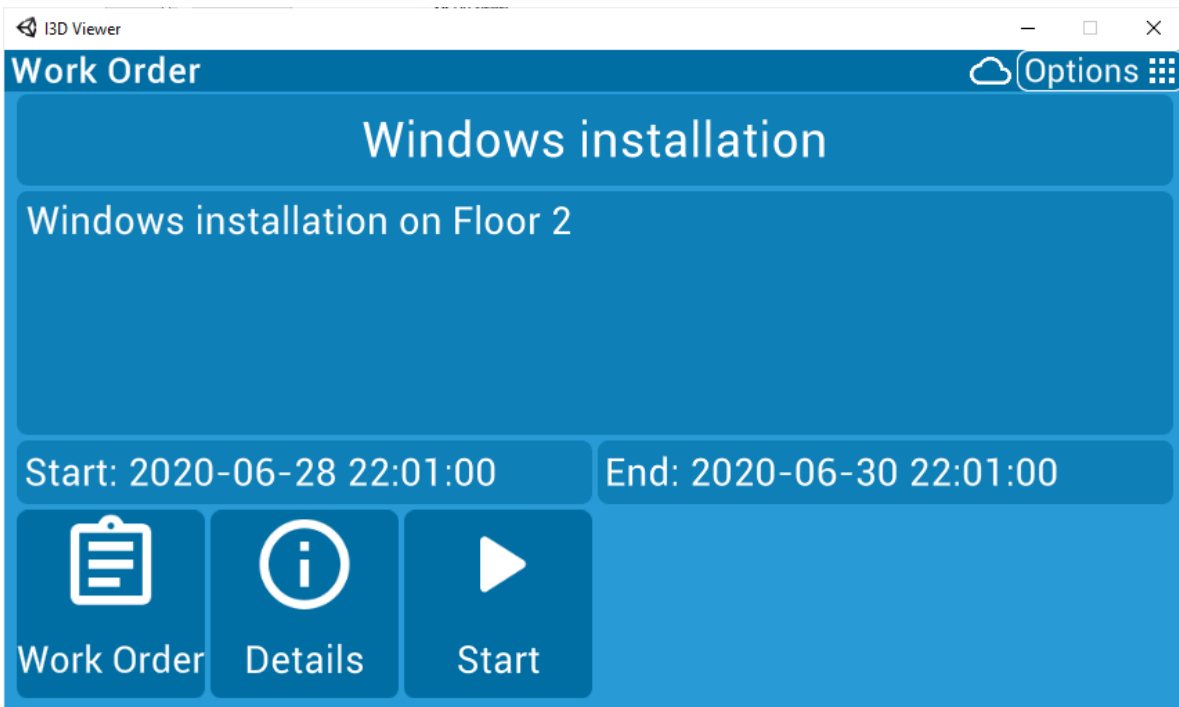


Figure 9 Manipulation with the task - view the details; start the execution

3.2.4 Work order execution and Task level reporting and evidence

After the worker starts the execution of a workorder, the system guides him step-by-step through the tasks of the work order. The worker is asked to start the execution of the oncoming action (Figure 15), while detailed description of the work to be provided is available. The option of skipping an action in the case of the work order having been paused and if the respective action has already been done – this way it is possible to redo the previous actions on a work order that has not been previously paused.

Once the worker starts the execution of any of the tasks, the application allows to attach as many multimedia files (pictures, video, and audio recordings) to the report as evidence, as needed (Figure 16). These multimedia files are linked to the tasks of the work order. After the worker finishes the execution of a task, the application requires from the worker to set the status of the task (Figure 19). To every task, also a textual note can be attached. In case, it is expected to collect some value, an input field to enter the collected value is available to the worker.

When there are multiple users involved with the work order and a particular task is set for another worker, a notification is raised for them to start, and the actual worker needs to wait or pause their work and work on other tasks meanwhile.

Thanks to the implementation of the BPMN methodology within our system, the work order no longer needs to be linear.

Elements of the BPMN methodology, such as exclusive gateways, parallel gateways etc., have all been successfully transformed to our system's internal models.

When dealing with exclusive gateway actions, the worker is supposed to choose which branch of the workflow is he or she meaning to continue working on. E.g., the viewer can ask whether "Is scaffold secure?", after which the worker needs to choose a YES or NO branch to continue (Figure 17).

When dealing with parallel gateway actions, the worker supposed to choose which task of workflow is he or he meaning to working on first. After all the parallel actions have been finished, the worker can continue working in linear way (Figure 18).

We have also implemented a service task for mailing communication, and a time limited task focused on the pre-defined time limit of the task. These tasks are both being executed automatically and without the worker's manual check.

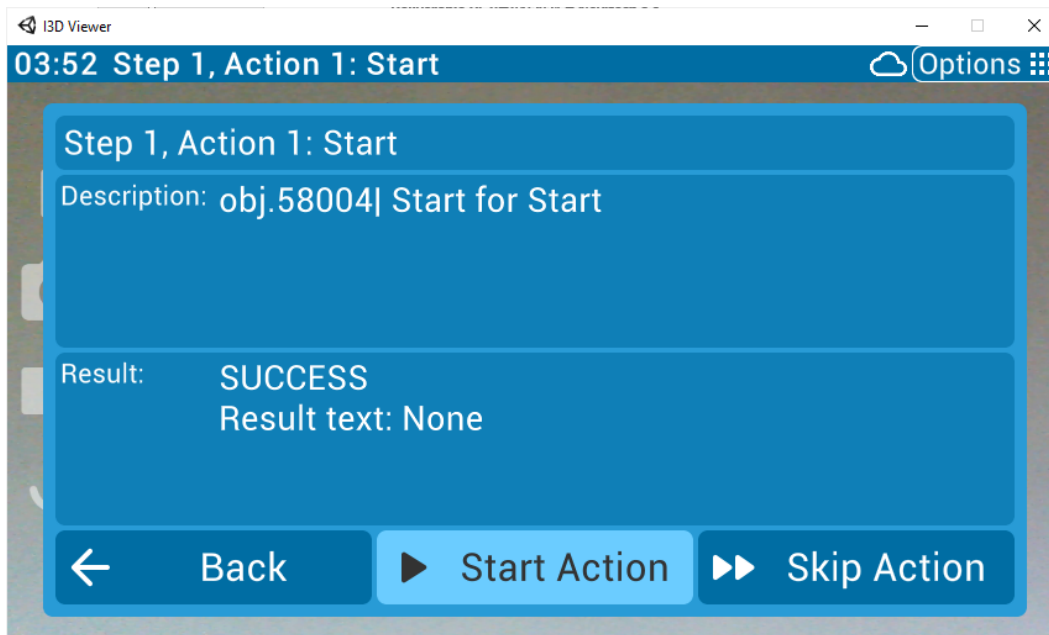


Figure 10 The start of execution of every task is confirmed by the worker

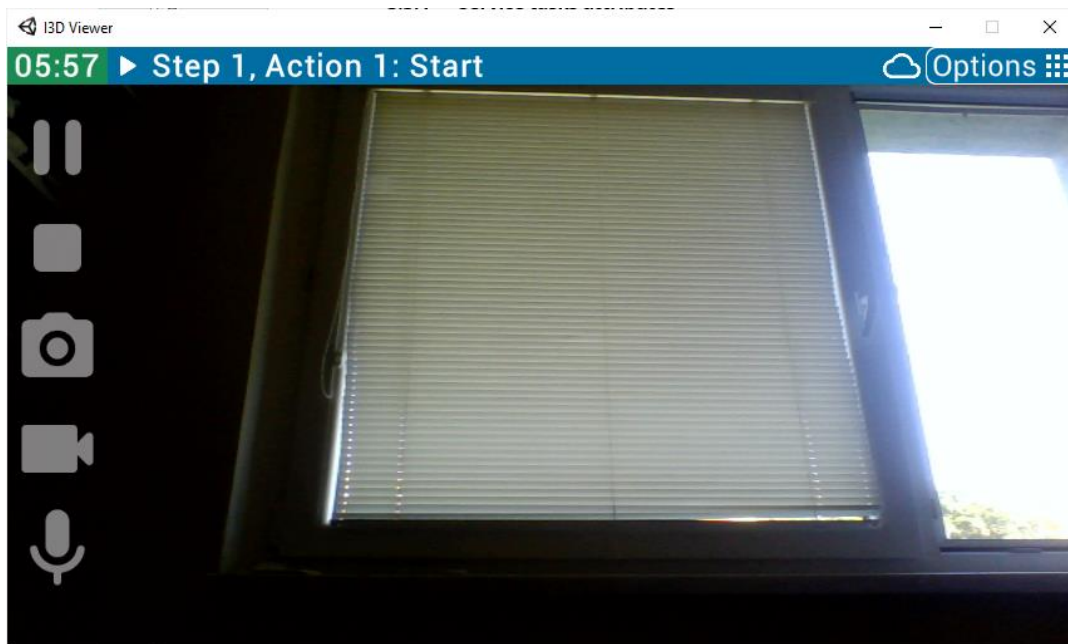


Figure 11 Quick buttons to attach evidence in form of multimedia files during task execution

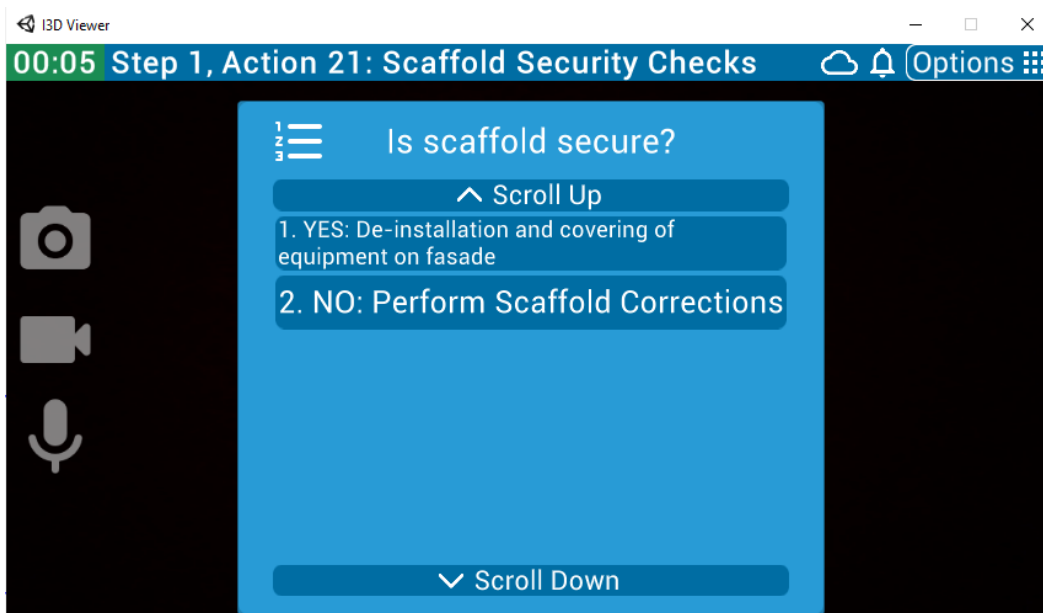


Figure 12 Exclusive gateway question before action

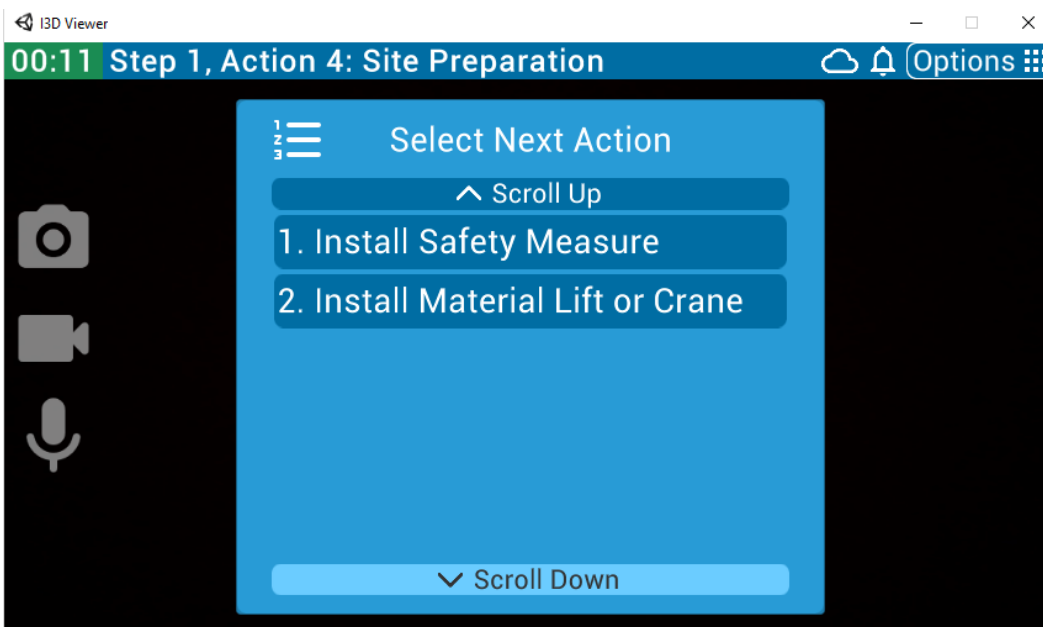


Figure 13 Parallel gateway – selection of which of parallel task start working on

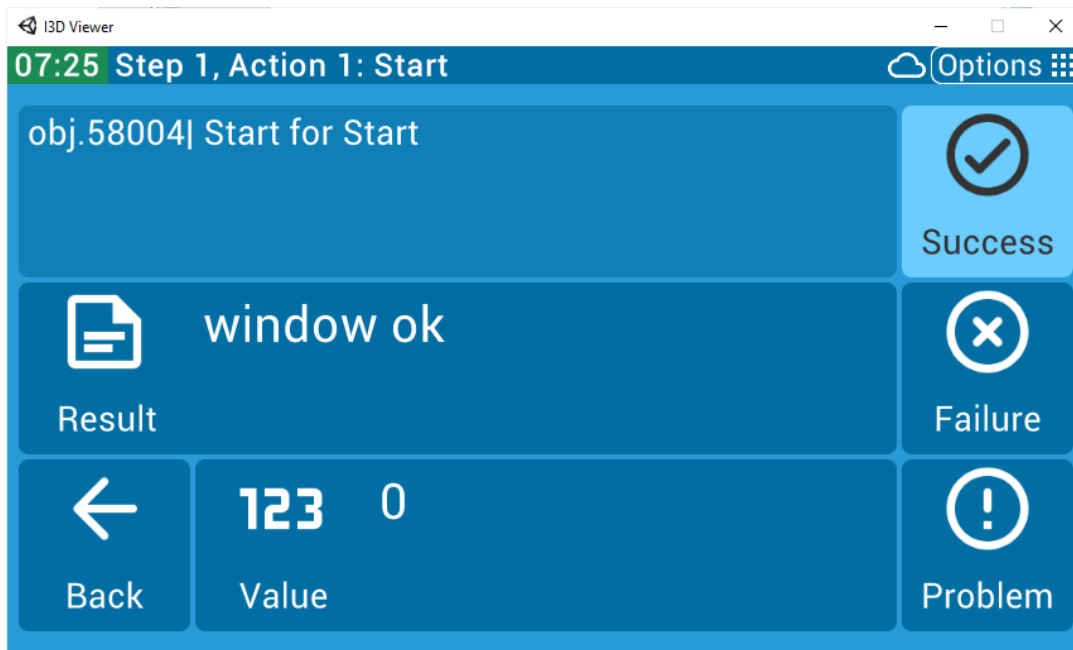


Figure 14 Status of an executed task (set by a worker). Notes and measured values can be added

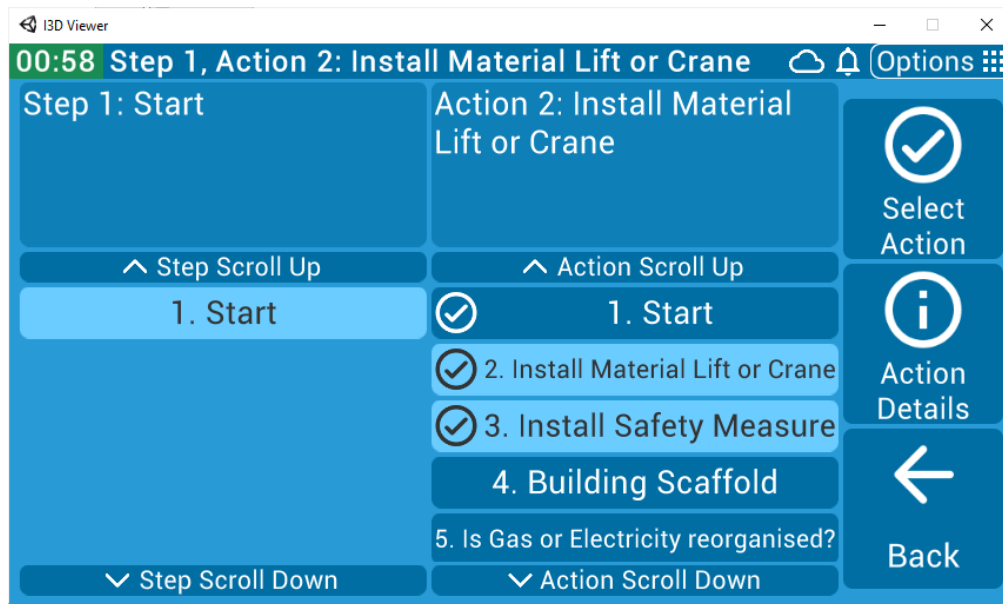


Figure 15 List of tasks of the work order

The user can anytime check the list of tasks of the actual work order, in which the status of tasks execution is indicated (Figure 20).

After the whole work order is finished, or if for some reason the worker needs to quit the execution, the application requires to set the status of the work (Figure 21). Available options are: Completed, Aborted and Paused.

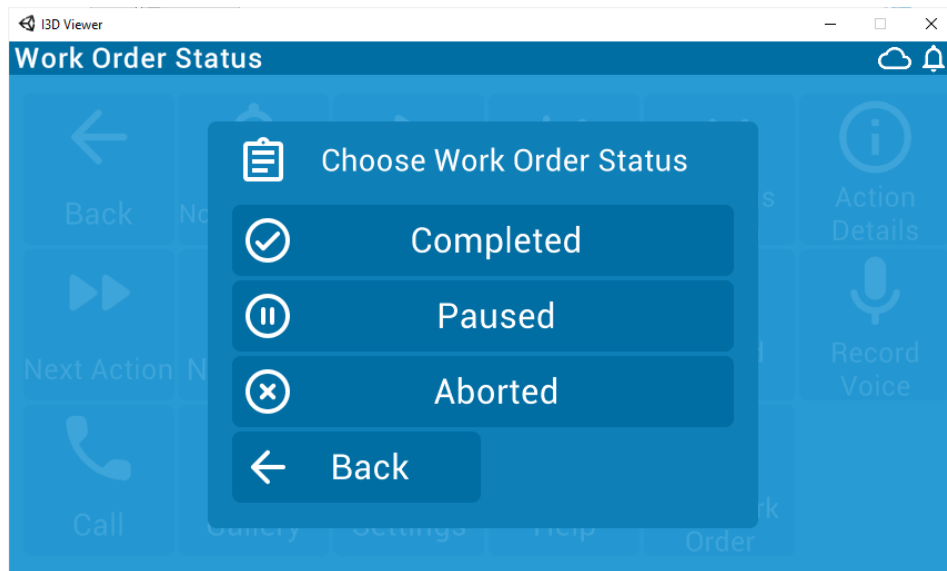


Figure 16 Statuses of a work order

The execution of the tasks is supported with additional tools (Figure 22) ready to help or further guide the workers during their work. The user is also able to call other users to ask for instant remote assistance. The rest of the buttons are for easier navigation in the list of assigned tasks.

The user can also customize the quality of the video recordings, based on the actual preferences (Figure 23). In case, a short video to document the status is required, High quality of the video recording is recommended. From the other hand, if, a long process is recorded for evidence, it is recommended to record in medium or low quality to keep a reasonable size of the recording. The resolution of the three predefined qualities is 854 x 480px for High Quality, 512 x 288px for Medium Quality and 256 x 144px for Low Quality.

The recording of video can be also automatized. If this option is selected (by button “Record each action”), a video recording about each action is created automatically. The user can anytime change this setting based on his own preferences.

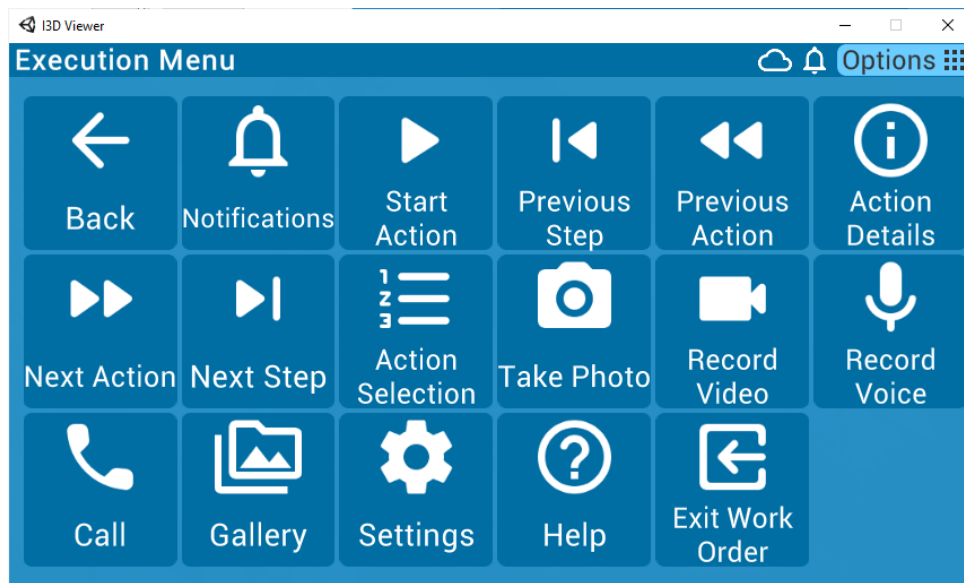


Figure 17 Tool set available for the worker in the app for mobile devices



Figure 18 Adjustable video recording quality

3.2.5 Notifications

Notification system is integral part of PWMA on-site support app. While working on the tasks, user can any time receive notifications, which is displayed on top of the app (Figure 24).

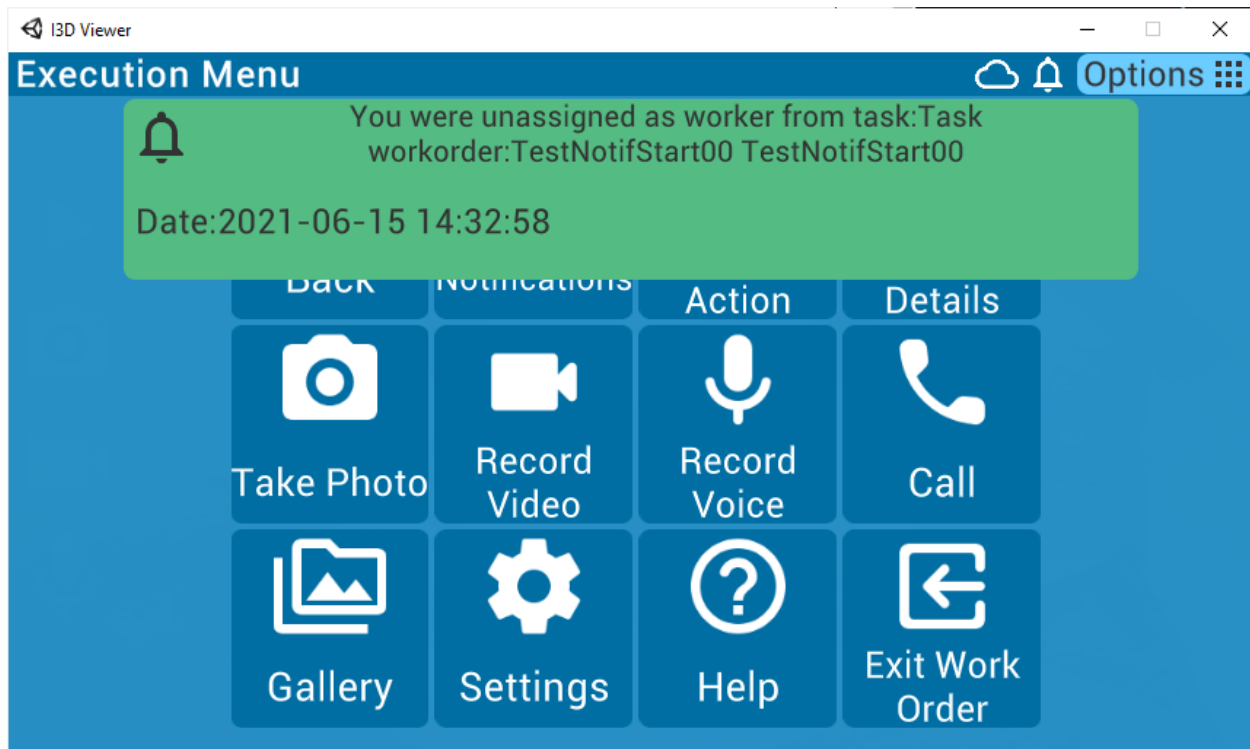


Figure 19 PWMA on-site support app – active

Worker can also list his recent notifications by pressing Options menu and panel Notifications (Figure 25). He can also send notification to workorder manager or other users as well. He can send message, title is workorder he is currently working on, he chooses priority and eventually H&S issues (Figure 26, Figure 27).

Notifications are sent automatically when work order ends, when the particular task has new worker assigned or when task for a particular worker ends (when more workers work on one work order).

Construction manager can also create notifications via notification web application and assign them to user(s) or user or notification groups.

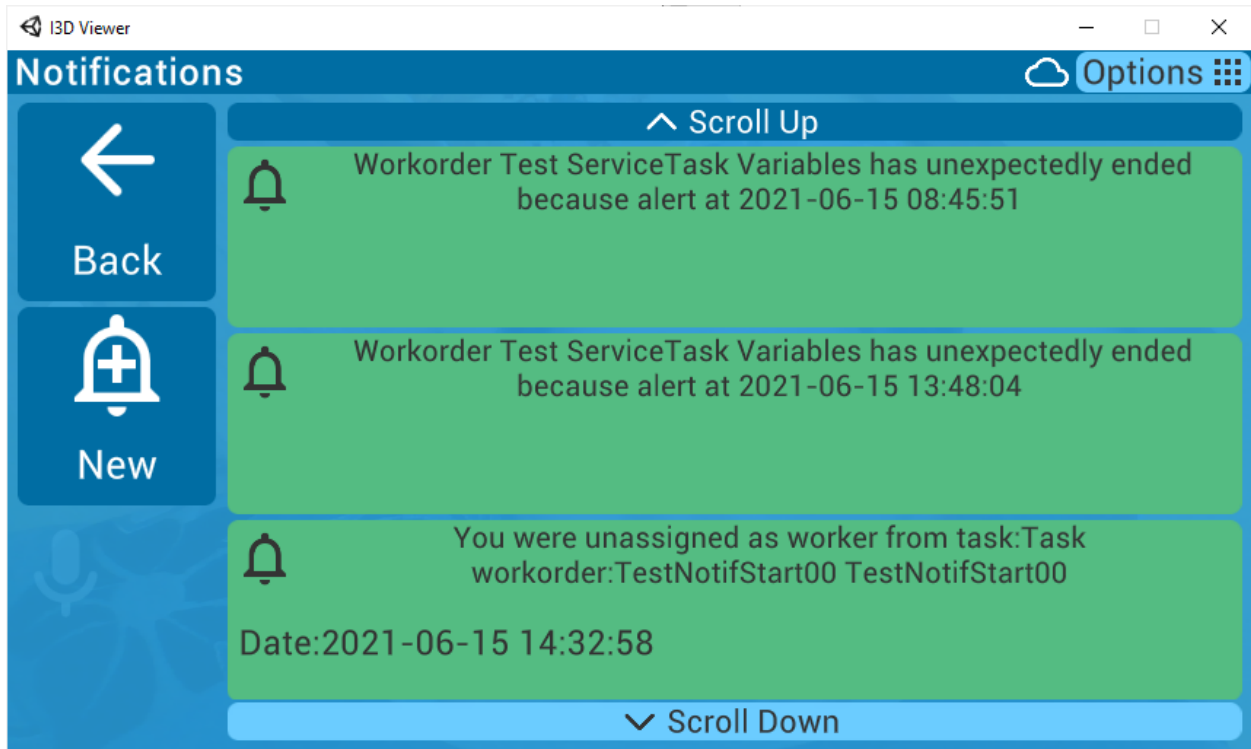


Figure 20 PWMA on-site support app – notification list

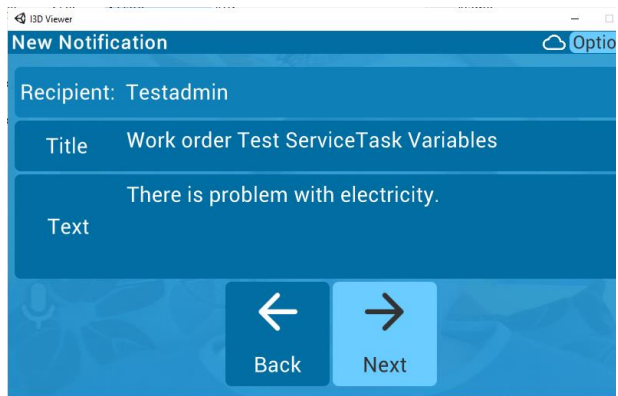


Figure 21 notification create

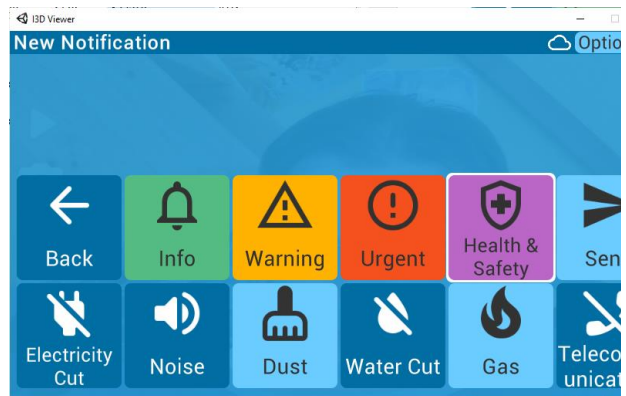


Figure 22 notification priority and H&S issues

3.3 WALKTHROUGH

This section provides an explanation of a general use of PWMA for on-site support for workers (internally called I3D Viewer).

Worker can download the application for their smart device or for smart VR/AR glasses. The application mainly supports Android OS, with an option to also utilize a Windows platform device, such as HoloLens AR glasses. After the start of the application, the worker fills their credentials to log into the system (Figure 9).

After login, the worker can choose a workorder from the list of workorders assigned to them (Figure 10) and press Start button in application (Figure 15). If the task objective is unclear, they can recall task details. After this, the actual workorder is started, and the worker is able to start with their work. During the workflow, they can capture videos or photos of their work, which are automatically uploaded to the server. After finishing the work, the worker clicks on the stop button on the action they were working on, specifying the status of the task (YES – done, PROBLEM – encountered some troubles, NO – not done), and being able to fill in various values (i.e. measurement) measured during the task (Figure 19). When all tasks are processed, the worker is asked to finish the workorder with status (Completed / Paused / Aborted) (Figure 21).

During the workorder, the worker can pause the work at any time, and continue later. They are also able to send notifications to managers or other workers at any time.

3.4 BACK-END

The application aims to provide in-the-field guidance on several fronts: e.g., to alert workers to hazardous components, assist them in reporting work progress (which will be automatically synchronized across BIMERR tools to provide all stakeholders an up-to-date view on activities and actual progress), guide them in the process of installation/assembly based on vendor information, etc. To achieve this, a back-end and deep integration with other BIMERR components is required. Since the app is an additional UI for the Workflow execution engine (D6.7), the components of the engine are used to produce content to be displayed in the smart glasses.

3.4.1 Workflow management

The workflow management part of the tool described in D6.7 is intended to be used to create and manage the know-how of a plant or company. In context of BIMERR, it is a repository of work processes, which are connected to a building reconstruction process.

A work process template can be a process definition from different perspectives like in the following:

- a) the whole reconstruction process containing an overview and scheduling of the main tasks, such as scaffold installation; safety measures installation; facade renovation; windows replacement; quality control.
- b) detail definition of some of the tasks, e.g., the process of installation of the new window or process of the quality check after the new windows has been installed. In the perspective of this deliverable, the second approach is important.

The workflow definition and management tool allows to create a step-by-step process definition, which needs to be followed by the worker on-site to achieve the wanted results by execution of the assigned tasks. This set of instructions can be for example a definition of a process of installation/assembly based on vendor information.

3.4.1.1 IMPORTING A WORK PROCESS SAVED IN A BPMN FILE

The manual work of the technologist using the workflow creation tool can be reduced in case, the work processes are already defined in third-party tools. The workflow engine provides the connectors to import any kind of work process defined in BPMN format (Figure 28).

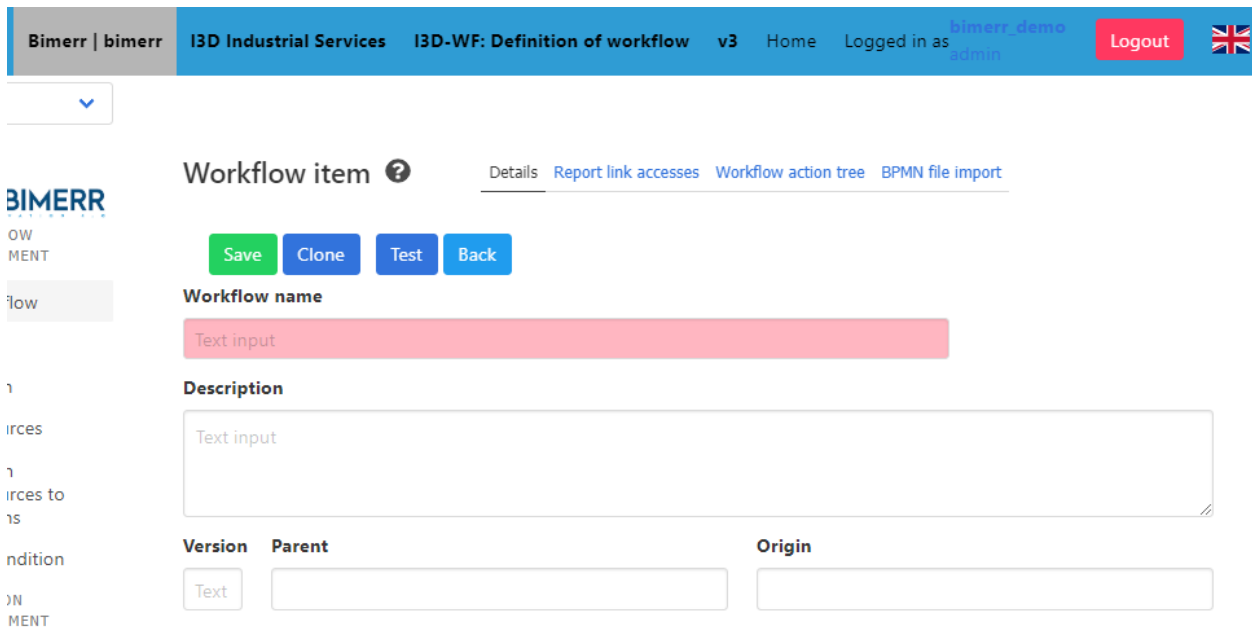


Figure 23 Creation of new workflow with option to load a BPMN file

The same work process can be imported from BPMN file multiple times, every time a new version of the work process template is created in the I3D system. For future reference, the external ID of the process is kept and displayed in the UI to inform the user about the fact, that it is an imported workflow created and initially managed outside the I3D (Figure 24).

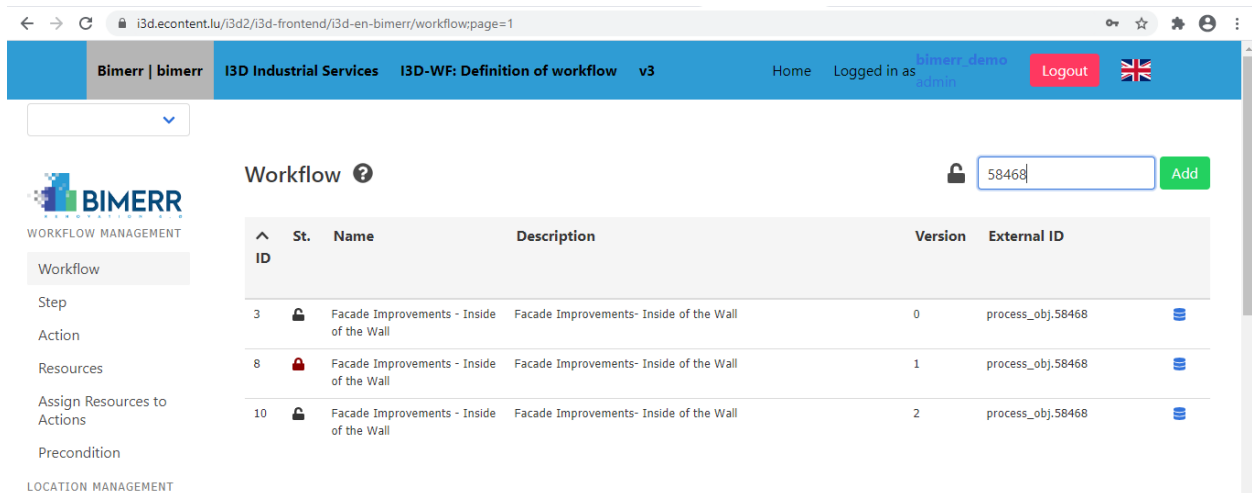


Figure 24 List of work process templates based on the BPMN with same external ID

The BPMN file contains all the information about the work process. It contains the sequence of tasks, their attributes, assigned KPIs and sometimes also the scheduling. The ETL tool of I3D is trying to collect as much information as possible. On top of it, the project manager has always the opportunity to extend the workflow with additional information as well as to modify the imported ones.

3.4.2 Digital twin (work order) creation

A work order or a so-called Digital Twin of a work process in context of I3D is an executable set of tasks. Any approved workflow (work process template) can be used to create as many real instances, as needed.

In the moment of creation of a digital twin, the exact work process template is processed, and an empty process log is created, which contains only the planned values of attributes (Figure 26). Before the process of creations is started, the planned starting date and planned finish date. Every work order has its main provider as the main worker and a work order owner representing a manager for this work. If there are any imported roles/lanes from the BPMN file, it is possible to assign every line to a specific worker (Figure 25).

- WORKFLOW MANAGEMENT
- Workflow
- Step
- Action
- Resources
- Assign Resources to Actions
- Precondition
- LOCATION MANAGEMENT
- Location
- HOTSPOT MANAGEMENT
- Hotspot
- Assign Multimedia to Hotspots
- MULTIMEDIA MANAGEMENT
- Upload Files
- Multimedia Overview
- WORKORDER MANAGEMENT
- Workorder**
- Workorder answer
- Device
- SETTINGS
- Provider
- Report links management
- Interactive Reports
- Attributes

Workorder

[Save](#)
[Back](#)

Workorder number

Workorder name

Description

Workflow

Space name

SpaceID
 [Select](#)

Main provider
[Add provider](#)

Workorder owner
[Testadmin](#)

Providers

<input type="text" value="Building Surveyor"/>	<input type="text" value="John.Doe"/>
<input type="text" value="BIM Modeler"/>	<input type="text" value="Test BuildingManager1"/>

Planned start

Actual start

Planned finish

Actual finish

Main device
[Add device](#)

Figure 25 Creation of a work order - digital twin

Workorder ?

[Details](#) [Related action list](#) [Flow diagram\(test\)](#) [Multimedia play list](#) [Report link accesses](#) [Service t](#)

Print workorder report

Full ▼

Interactive Report

Export JSON

Save

To completed

Delete

Back

Workorder Result ?

Type to search

^	Step ID	Step Name	Act ID	Act Name	Act Description	Provider Name	Result Text/Value	Answer Type
	2958	64	Start	590	Start Event	Start Event	John Doe	Empty
	2963	64	Start	595	Send Mail for MEP scannin...	Send Mail for MEP scanning exceeded time	John Doe	Empty
	2964	64	Start	596	Send Mail for structural ...	Send Mail for structural scanning exceeded time	John Doe	Empty
	2965	64	Start	597	Send Mail to start Scan-t...	Send Mail to start Scan-to-BIM Geometry stage	John Doe	Empty
	2966	64	Start	598	Send Mail for start Scann...	Send Mail for start Scanning	John Doe	Empty
	2967	64	Start	599	Send Mail for scanning ex...	Send Mail for scanning exceeded time	John Doe	Empty
	2968	64	Start	600	Send Mail to	Send Mail to start Scan-to-	John Doe	Empty

Figure 26 Empty process log created

3.4.3 Digital twin monitoring and management

The I3D provides different User Interfaces (UI) via which the work order can be managed. The most important are:

- the web-based interface, which is supposed to be used by the project manager and
- the other UI is the application described in this deliverable, which can be used on mobile and wearable devices, such as smart glasses, cell phones and tablets.

While the web-based UI focuses more on administrative users, like project managers, the application is intended to use by workers, foreman, quality controllers and other on-site users.

The project manager can follow the status of execution of any of the reconstruction tasks via graphical visualization of the work order. This provides a quick overview for the project manager about the overall status of the reconstruction process. The statuses of the tasks

are visualized by green, red, and grey colors to indicate, which tasks has been executed correctly and which not. Interaction with the tasks can be done by clicking on the elements in the flow diagram (Figure 27).

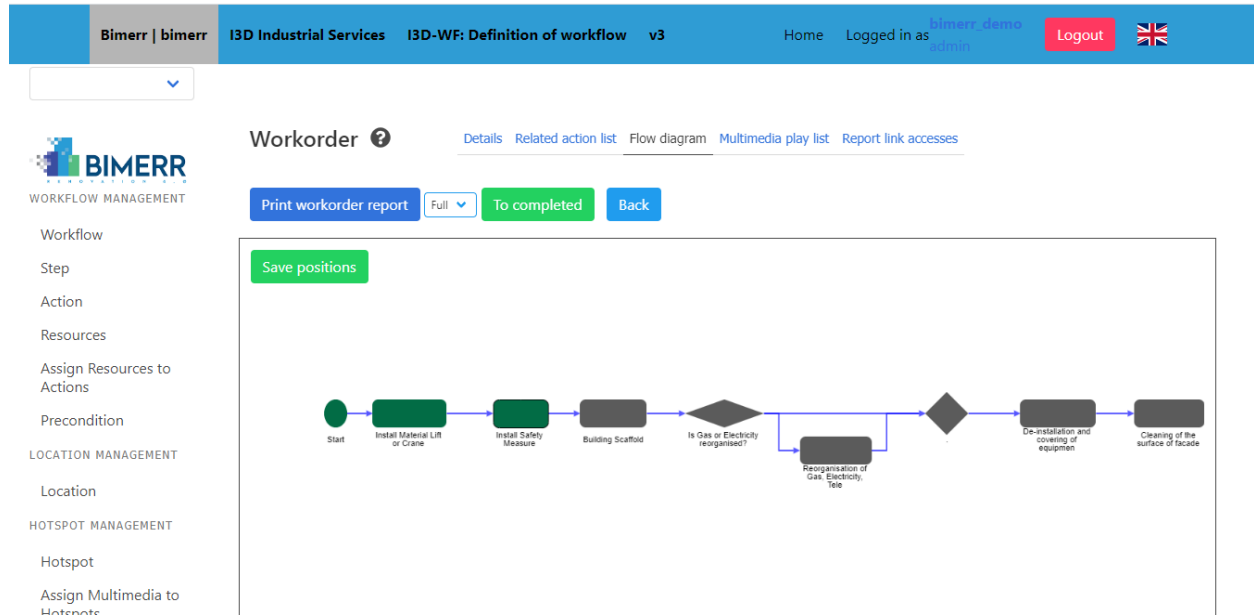


Figure 27 Visualization of the running work order

4. INTEGRATION WITH BIMERR TOOLS

This chapter contains a detailed view on the integration strategies used by the different components to interact with the BIF and between them. Integration of the application is realized primarily to this component. Integration with the rest of the BIMERR tools is realized via the Workflow execution engine.

4.1 INTEGRATION WITH WORKFLOW EXECUTION ENGINE (D6.7)

The application for on-site support of workers and the Workflow execution engines are created in parallel, thus their integration is implicit by their architecture. The application for workers uses the workflow execution engine as its back-end and the applications are sharing the same database structure and REST API, which is used by the Web-based GUI used by the Project manager.

The workflow execution engine allows to define and manage work process templates and by using these templates to generate real executable work orders. These work orders can be executed directly in the web interface of the workflow execution engine by the project manager or by workers using the application for on-site support.

The same approach will be followed with integration to the notification system, which is going to be implemented as part of D6.7 “Adaptive workflow management & automation tool 2”.

4.2 INTEGRATION WITH MODELING TOOLS

Since the Workflow execution engine is only one of the components of the PWMA toolkit, it is important, that it works in an integrated way. As it was already mentioned, the BPMN standard format has been selected as a common communication language between the modeling components and the execution engine. Selection of this standard is a far-seeing decision which allows to replace the modeling tool, or the execution tool as well. BPMN model is passed to PWMA backend automatically by API. It is also possible to do it manually.

4.3 INTEGRATION WITH APP FOR RESIDENTS

Integration with the App for residents is realized via the process log of the digital twin, via which up-to-date information about the running process are shared. Based on the provided information, the app for residents can indicate for its users' important details and information about the on-going reconstruction process, like the progress of the reconstruction work, to indicate the issues, delays, schedule of on-going tasks and other circumstances of the reconstruction process. Instant information exchange is going to be realized via the notification system.

4.4 INTEGRATION WITH MONITORING TOOL

Accessing data from the Workflow execution software by other components of the PWMA toolset is as important as importing the BPMN model. The deployed REST API provides all the information needed for further analysis and evaluation of the work process models.

The data provided by the web-services are used by the KPI dashboard of the modelling environment to show the real KPIs. In the actual version of the prototype, the only KPI that was seemed to be relevant and fitting the system was the current execution time KPI.

5. CATALOGUE OF TOOLS

This chapter describes where and how to access the tools presented in this deliverable.

5.1 WORKFLOW EXECUTION ENGINE (D6.7)

The workflow execution tool is available in form of SaaS on address <https://i3d.econtent.lu/bimerr/>.

Users registered within the BIMERR identity provider are allowed to login to the PWMA tools for roles of Project Manager, Construction Manager and Construction Worker. New users are required to log in to the application to be registered on the PWMA toolset.

Users need to fill “client name= bimerr” to get to the application.

Notification web app is also available as SaaS on address <https://notifications.econtent.lu/>

5.2 SMART GLASS APPLICATION FOR ON-SITE RENOVATION WORKER SUPPORT (D6.9)

The application for mobile devices and a version runnable on Windows can be downloaded from <https://i3d.econtent.lu/bimerr/download/>.

The user credentials for the application are the same as the web interface - same credential as another BIMERR tools. The “company name” needs to be set to “bimerr” (Figure 33).

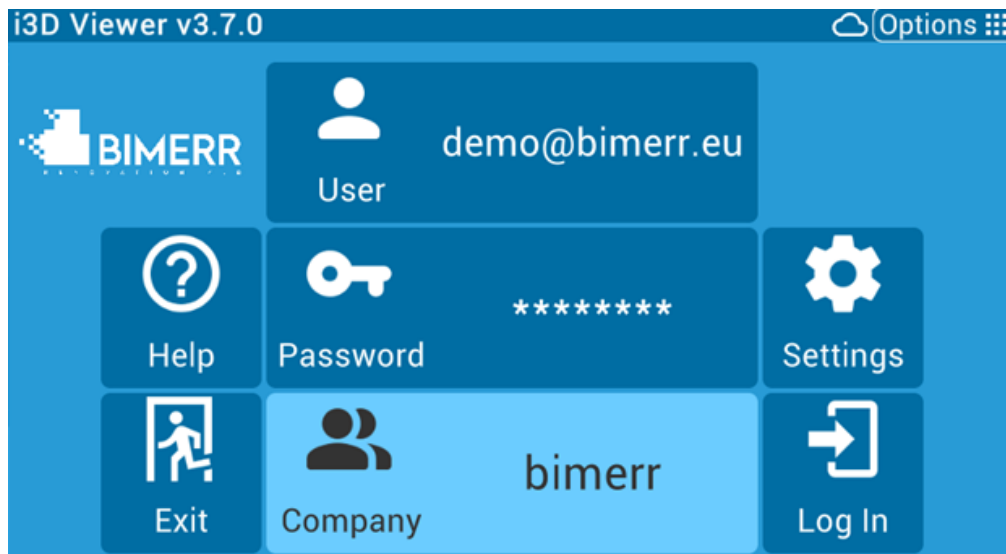


Figure 28 Logging to PWMA for on-site support

6. CONCLUSIONS

The technology that is described in this deliverable corresponds to the approach that is described in D6.2 “Adaptive Renovation Process & Workflow Models 1”.

This deliverable introduces the PWMA application for on-site support of the workers and the related back-end – the workflow execution engine.

This document explains the smart-glasses application:

- First, description of the I3D system and terms used.
- Second, description of the main functionalities of the application, which are user authentication, work order overview, interaction with assigned task and reporting on the executed tasks.
- Support for selected wearable smart glass.
- Integration to the other BIMERR tools

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