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BIMERR D10.7 LIVING LAB ACTIVITIES EVALUATION REPORT 2

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UPM	Universidad Politecnica De Madrid	Spain
UBITECH	Ubitech Limited	Cyprus
SUITE5	Suite5 Data Intelligence Solutions Limited	Cyprus
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NT	Novitech As	Slovakia
FER	Ferrovial Agroman S.A	Spain
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LIST OF ABBREVIATIONS

BIMERR	BIM-based holistic tools for Energy-driven Renovation of existing Residences
ICT	Information and Communication Technologies
AEC	Architect Engineering Construction
PWMA	Process Workflow Management & Automation
ARIBFA	Augmented Reality In-situ Building Feature Annotation
RenoDSS	Renovation Decision Support System
UI	User Interface
DoA	Description of Action

1. EXECUTIVE SUMMARY

The Deliverable “D10.7 - BIMERR Living Lab Activities Evaluation Report 2” analyses the implemented Living Lab activities in the BIMERR project performed between M13 and M32 of the project following the design phase of Living Lab activities that was established in D10.2 – Dissemination and Communication Plan (M06). Furthermore, the Living Lab activities that were carried out up to M12 of the project were previously reported in “D10.6 - BIMERR Living Lab Activities Evaluation Report 1”.

The Deliverable 10.7-“Living Lab Activities Evaluation Report 2” of the BIMERR project, will be updated at the end of the project when all foreseen Living Lab actions have been implemented.

2. INTRODUCTION

2.1 PURPOSE, CONTEXT AND SCOPE OF THIS DELIVERABLE

This deliverable presents the analysis of the establishment and implementation of Living Labs and their methodology, following their initial presentation in M06 at D10.2 - Dissemination and Communication Plan. The aim of Living Lab activities, is to establish an open innovation 4.0 and value co-creation framework, involving end-users and stakeholders either directly participating in or affected by the project and ranging from the project consortium partners to relevant end-users and stakeholders, along with scientific, technological and business communities.

The BIMERR concept has been conceived and elaborated by combining the clear need and willingness of construction companies of the consortium to further enhance/diversify their digital tool base with technology/solution provider partners. Furthermore, these aligned intentions and efforts construct a solid research and academic foundation to provide an innovative system that will be demonstrated and validated in relevant environments of real renovation activities. The BIMERR consortium is actively promoting the system using an evidence-based approach and this will be built on the use of the tools during actual renovation activities under real life conditions. The efforts from consortium partners to actively promote the BIMERR system and the value it can deliver to all stakeholders is further enhanced by the dissemination and exploitation activities of the project. The aim is to involve all the necessary AEC stakeholder value chain in the co-creation and co-design of added value solutions that respond to emerging market and sector needs.

The Living Lab operation in the BIMERR project extends from the very early stages of the project implementation (user requirements phase) up to the pilot evaluation phase, aiming at the establishment of an iteration and open collaboration process that will accelerate collaborative knowledge generation and integration, technology customization and validation against real market and user needs, as well as end-product definition and go-to-market strategy creation. The Living Lab activities involve the definition of various interaction and collaboration mechanisms. In addition, targeted living lab workshops are taking advantage of the input of key construction stakeholders and the pilot sites end-users.

The main purpose of the Living Lab activities is to provide a user-centric approach and a co-creation of the final BIMERR solution. With this new solution, the aim is to create a new product that is user-driven and to promote the adoption of the BIMERR solution as renovation-enabling toolkit through intense dissemination and knowledge transfer of the project outcomes toward the targeted stakeholders, reaching out to audiences within and beyond the EU.

This deliverable reports the Living Lab actions performed from M13 and up to M32 of the project.

3. OVERVIEW OF BIMERR LIVING LABS

3.1 DEFINITION OF BIMERR LIVING LABS

As elaborated in detail in D10.2 - Dissemination and Communication Plan, the Living Lab concept is a user-centered, open-innovation environment integrating concurrent research and innovation processes within public-private-user partnerships. The concept of Living Lab is based on the user co-creation approach integrating research and innovation processes. The Living Lab activities are integrated through the co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and related technological artefacts in real life use cases. These specific use cases involve user communities, not only as passive observers but also as main source of formation of the final outcome of the project. This approach allows all involved stakeholders to concurrently consider both the global performance of the outcomes or results of the project and their potential adoption by users. Therefore, the Living Lab activities start at a very early stage of the research and the development of all elements of the final product, in order to involve the user-centered approach to the entire lifecycle of the project. The Living Lab activities, which integrate both user-centered research and open innovation, are based on the following four main activities:

"Co-creation": bring together technology push and application pull (i.e. crowdsourcing, crowd-casting) into a diversity of views, constraints and knowledge sharing that sustains the ideation of new scenarios, concepts and related artefacts.

"Exploration": engage all stakeholders, especially user communities, at the earlier stage of the co-creation process for discovering emerging scenarios, usages and behaviors through live scenarios in real or virtual environments (e.g. virtual reality, augmented reality, mixed reality).

"Experimentation": implement the proper level of technological artefacts to experience live scenarios with users while collecting data which will be analyzed in their context during the evaluation activity.

"Evaluation": assess new ideas and innovative concepts as well as related technological artefacts in real life situations through various dimensions such as socio-ergonomic, socio-cognitive and socio-economic aspects; make observations on the potentiality of a viral adoption of new concepts and related technological artefacts through a confrontation with users' value models."

3.2 THE KEY OBJECTIVES OF LIVING LABS

The BIMERR Living Lab activities are oriented towards fulfilling the following objectives:

1. To disseminate widely all the results and the outcomes of the BIMERR project towards all the targeted end-users, beneficiaries and construction/renovation stakeholders.
2. to generate a broad awareness, engagement and involvement throughout the BIMERR activities.
3. Receiving feedback from end-users and targeted beneficiaries during the project's lifecycle to optimize its different aspects.
4. To create new opportunities for additional exploitation and replication of the projects results after its official completion (validation phase).
5. To support all the various training activities of AEC community professionals during the BIMERR demonstration activities (validation phase).

Up to M32, the BIMERR Living Lab activities have targeted towards fulfilling the first three objectives. Objectives 4 and 5 will be eventually fulfilled in the validation phase of the BIMERR project (M33-M45).

4. BIMERR LIVING LAB METHODOLOGICAL FRAMEWORK

4.1 METHODOLOGY

The Living Lab methodology is the main framework which supports horizontally several other aspects of the BIMERR project, and it was initially presented in the D10.2-Dissemination and Communication Plan 1 in M06. The Living Lab approach adopted by BIMERR, engages end-users from the very early stages of any new idea cultivating motivation to share and discuss experiences as well as requirements. Furthermore, one of the main novelties of BIMERR is the involvement of end-users and stakeholders in the co-creation of the BIMERR framework (user-driven approach).

As described in the Deliverable D3.1 – Stakeholders Requirements for the BIMERR system, in order to meet the BIMERR objectives, user requirements that later formed the basis for the definition of the BIMERR tool architecture, were produced. The BIMERR solution addresses many aspects of the renovation process and at the same time involves many different stakeholders. For this reason, the aim of the Living Lab Methodology is to establish an open innovation 4.0 and value co-creation framework, involving these different end-users and stakeholders either directly participating in or offered by the project and ranging from the project consortium partners to relevant end-users and stakeholders (AEC professionals), along with scientific, technological and relevant business communities.

Moreover, the methodology of the BIMERR Living Lab is based on the User Engagement concept that aims to the constant and effective engagement of the end-users to the BIMERR project. Therefore, the end-users and main project beneficiaries are collectively placed at the center of all research, innovation, demonstration and communication activities of the BIMERR project, which adopts a User-Driven Innovation Approach towards addressing emerging end-user and market needs, critical for the successful project implementation and the realization of its anticipated impacts. The main aim of the User-Driven Innovation Approach is to involve renovation professionals and building residents/owners throughout all stages of the project life-cycle, as the key enablers of the BIMERR innovation process, towards encouraging active and collaborative contributions in the development of a BIMERR-based ICT system to accelerate energy efficiency renovation across Europe. In the overall User-Driven Innovation approach it is necessary to incorporate agile ICT implementation methodologies in conjunction with the continuous validation and verification processes. The main goal is to manage cross-functional teams and ensure the establishment of an effective BIMERR system with the use of innovative, cross-disciplinary integrated ICT solutions.

One of the main characteristics of the User-Driven Innovation approach is the continuous interactions between different beneficiaries, end-users and project team members that will be encouraged to minimize deviations between expectations and final outcomes. In

addition, the target is to divide the project final outcomes into intermediate marketable results.

Several tools such as templates and questionnaires have been produced by the partners, and subsequently used by the pilot participants in the context of the Living Labs for interviewing the targeted user groups during especially organized workshops. Details about the employed methodology are provided in the following sections.

4.2 TIMEFRAME

Based on the planning that was developed and reported in D10.2- Dissemination and Communication Plan 1 in M06, all Living Lab activities are planned to be implemented in three distinct phases:

- The first phase of Living Labs was the design phase that concluded in M6 of the project. Main scope has been to gather stakeholder specifications and requirements which would later be used during the development of the BIMERR system. In cooperation with Task 3.1, questionnaires for different stakeholder groups were designed for the elicitation of end-user requirements. Those requirements were then used as the core for the open-innovation design methodology for the BIMERR tools. Meeting those requirements by the end of the project was set as an overarching goal.
- The second phase of the Living Lab activities was defined as the Implementation phase. Here, the Living Labs were used to establish an adequate live feedback loop between the stakeholders and the technology/solution providers. More in detail, the stakeholders in this phase were asked to provide feedback for the features of BIMERR tools during their development in order to establish the co-creation framework and maximize their effect on the characteristics of BIMERR tools. This was achieved through workshops containing direct demonstration of features by the technology providers to specified user groups, or online demonstration of BIMERR tools to specific user groups with the scope to receive their feedback and implement their needs in the BIMERR tools. The present document is reporting Living Lab actions covering this phase of the project.
- The third phase has been defined as the Validation phase. In this, the evaluation of the BIMERR tools will be performed in accordance with the initially set end-user requirements. Targeted stakeholders shall be actively participating in the end-product definition and go-to-market strategy creation by getting involved in the final rounds of workshops as well as in the training activities and other dissemination activities of the project.

4.3 MAIN USER GROUPS

During the design phase, building upon the user-driven approach of Living Labs, the first step was the definition of BIMERR end-users. After extensive internal discussions with the BIMERR pilot partners, all the types of potential BIMERR tool end-users were identified. The 17 user groups identified in the use cases were grouped in 7 main groups based on their role in the use cases and the BIMERR component (tool) they would be using. The remaining user groups were allocated to (or represented by) one of the seven main user groups since their role is considered either complementary or derivative for the use cases. Figure 1 depicts the users' classification to main and secondary user groups.

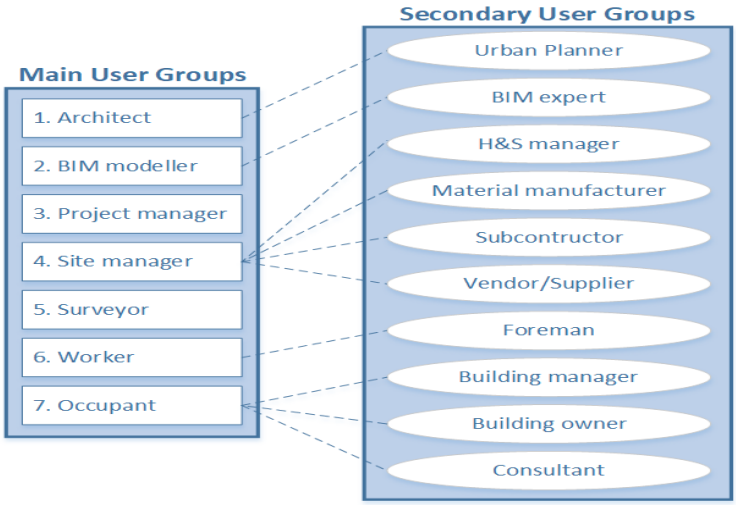


Figure 1: User groups and categorization to main and secondary groups

Based on this classification, The Living Lab activities targeted the identified user groups and their respective feedback. At this point it should be mentioned that the only user group that was not engaged in Living Lab activities was that of the building occupants. This was hindered by the consecutive measures that were implemented across Europe to tackle the ongoing health crisis of COVID-19. Communication with the occupants was almost impossible since any physical contact with them was forbidden for an extended time period. Engagement with this specific user group will be intensified during the validation phase of the project.

5. IMPLEMENTED LIVING LAB ACTIVITIES

5.1 DESIGN PHASE OF LIVING LAB ACTIVITIES (M01-M06)

As already presented in D10.2 Dissemination and Communication Plan, the design phase of the Living Lab activities of the BIMERR project outlined the concept and the activities that shall be included in the Living Labs. In detail, as described in D10.2, during this period, the methodology, the timeframe, the activities and the specific means for the implementation phase of the living lab activities were rigorously designed and presented in M06.

5.2 IMPLEMENTATION PHASE OF LIVING LAB ACTIVITIES (M07- M12)

Following the design phase of the BIMERR Living Lab activities, the implementation phase begun in M07 of the project. The actions implemented up to M12 of the project were reported in M12 in D10.6 - BIMERR Living Lab Activities Evaluation Report 1. A brief summary is given here.

As part of the Living Lab activities a questionnaire was initially released in a dedicated space of the BIMERR website. This questionnaire was targeting specific end-user groups to capture their preferences. The detailed structure and outcome of these questionnaires was reported and can be found in D10.6 "Living Lab Activities Evaluation Report 1" released in M12. In the same report the first round of the Living Lab workshops was described and outlined. In summary these workshops included:

- On the 19th of June (M06), in Ferrovial Agroman's offices in Madrid, and on the 12th of July (M07) in the IVE's offices (Instituto Valenciano de la Edificación), Ferrovial Agroman's Urban rehabilitation Area and its R&D Department organized two different requirements workshops in the framework or the BIMERR project. The aim of the workshops was to lead debates and conversations about the state and need of the renovation industry. The workshops included participants from all the main user groups apart from the occupants. As the pilot sites were not yet finalized, targeting building occupants was not possible. Once the buildings to be renovated using the BIMERR tools would be chosen, then their occupants would be engaged.
- In May 2019 (M05), BIMERR project workshops were held in Warsaw, Poland by BUDIMEX. The meetings were attended by representatives of selected organizations, focused around the construction industry, as well as BIM experts and construction supervision employees. The aim of the workshops was to determine the expectations and needs of potential users and recipients of innovative tools, which would later be the result of BIMERR's design work. The

second workshop which was held in August 2019 (M12) had totally a different approach. This time Budimex focused on feedback from a specific construction site in Bydgoszcz, Poland. The discussion with the participants was moderated based on questions from the Questionnaires. All the participants had working experience relevant to constructions while most of them were familiar with BIM models and renovation technology. In total 17 participants attended workshops in Poland.

5.3 IMPLEMENTATION PHASE OF LIVING LAB ACTIVITIES M13- M32

The global COVID-19 pandemic that occurred around M14 of the project greatly affected the implementation of the planned Living Lab Workshops. Although the planned workshops did eventually take place, their timing was significantly altered. By M18 of the project, a second round of Living Labs with three more workshops (one per pilot site in Spain and Poland and one in the Greek pre-pilot site) were scheduled to take place. However, due to the restrictions applied all over Europe, the second round of living labs was initially postponed for M26 of the project in hope that restrictions on traveling would have been lifted by then. As this did not occur, it was decided that the consortium should proceed to implement the workshops using an online format. At this stage, scope was to present as extensively as possible the functionalities of the under development BIMERR tools to building renovation stakeholders for dissemination purposes but also as an opportunity for the consortium technology developers to receive feedback for improving their tools.

To adapt to the proposed online format of the workshops, several online meetings were held with the consortium partners to identify the best and most efficient way of implementing the events. With the BIMERR tools being mostly software packages, it was decided that their respective capabilities and functionalities should be showcased in the form of live demos during which end-users would observe and comment accordingly. While the initial approach was to create a virtual renovation pipeline where the contribution of each tool in the same renovation scenario would be showcased, it was finally deemed counterproductive for this phase of the Living Labs since tool integration and interoperability was not yet completely established. This approach was deemed more suitable for the last phase (validation) phase of the Living Labs when the actual pilot renovations will have taken place and the interoperability of all BIMERR renovation support tools will have been established and validated.

The workshops were held online and had a duration of approximately 2 hours. During this time, technology developing partners presented live demonstrations of their individual tools showcasing basic capabilities and functionalities. The partners that participated were UEDIN showcasing the Scan-to-BIM tools, Xylem Technologies with a

live demo of the RenoDSS, CERTH with ARIBFA and PWMA for residents App and Novitech with the UI of the PWMA for project managers. After the workshop, online feedback questionnaires (developed by the technology developing partners presenting the tools) were sent to the participants. All three workshops (Spain, Poland, Greece) had a common format. The same BIMERR tools were presented by their respective owners. A more detailed view of the workshop structure and content is presented below.

Introduction to BIMERR project

Presented each time by the respective workshop organizing entity (FER, BX, CERTH)

BIMERR Tool #1: **Scan-to-BIM**

Description: The Scan-to-BIM Tool is a software solution for the (semi-)automated generation of as-is Building Information Models of existing buildings from reality capture data (mainly 3D point clouds and pictures). The tool deploys innovative data processing techniques, including machine learning, to deliver IFC models that can be meaningfully used for assessing building energy performance assessment and planning refurbishment. The tool is developed using open-source technology and manipulates data in open formats (e.g., E57 and IFC).

Presented by: Frederic Bosche – The University of Edinburgh
Valero Rodriguez Enrique – The University of Edinburgh

BIMERR Tool #2: **ARIBFA - Augmented Reality Enabled In-situ Building Feature Annotation**

Description: The ARIBFA tool is responsible for presenting BIM 3D visualizations and spatially annotated information on-site during the renovation process to architects, contractors, and building managers through an Augmented Reality (AR) interface. The main functionalities covered by ARIBFA involve the localization of the user in an indoor environment, based on which the 3D BIM model will be overlaid on top of the physical location of the building. Using object recognition methodologies, elements to be changed or worked upon during the renovation will be highlighted in the AR visualization, as well as Health and Safety annotations and designated work areas, as defined in the daily work schedule.

Presented by: Thanos Tsakiris – CERTH/ITI

BIMERR Tool #3: **RenoDSS - Renovation Decision Support System**

Description: RenoDSS provides an accurate estimation of the energy, cost, and environmental impact trade-offs of alternative renovation scenarios. The estimation of post-renovation energy consumption is based on energy data models, structural and geometrical properties of the building, materials, HVAC systems, residents' usage profile, as well as weather data. RenoDSS also takes the environmental impact of the renovation and the interaction with surrounding buildings into account. All KPIs and details of possible renovation scenarios are shown in an intuitive user interface which enables the renovation designer to select the optimal renovation scenario in terms of costs, energy consumption, and environmental impact.

Presented by: Stefan Fenz – Xylem

BIMERR Tool #4: **PWMA for Residents - Process & Workflow Modelling & Automation Toolkit**

Description: PWMA provides a set of tools to design, verify, simulate, execute, monitor, and analyze the renovation process. It orchestrates the tasks of the renovation process and provides UI for all the key stakeholders of the process to cover all phases of the renovation.

Presented by: Thanos Tsakiris – CERTH/ITI

BIMERR Tool #5: **UI for Project Managers App for on-site workers support - Process & Workflow Modelling & Automation Toolkit**

Description: PWMA provides a set of tools to design, verify, simulate, execute, monitor, and analyze the reconstruction process. It orchestrates the tasks of the renovation process and provides UI for all the key stakeholders of the process to cover all phases of the renovation.

Presented by: Ján Varga – Novitech
Martin Straka – Novitech

Open debate about the BIMERR tools and time for questionnaires

Moderated each time by the respective workshop organizing partner (FER, BX, CERTH):

5.3.1 Online workshop for stakeholders in Spain

The online workshop for stakeholders in Spain was organized by Ferrovial Agroman and took place on Friday May 7th. The followed agenda was:

1. Introduction/Welcome (5 minutes – FERROVIAL)

2. Presentation of the BIMERR Project to BIMERR/context of the Workshop (10 minutes-FERROVIAL)
3. Tools presentation (90 minutes - Approximately 15 minutes per tool with Q&A – XYLEM, CERTH, NOVITECH, UEDIN)
4. Debate/Wrap up/next steps (15 minutes)

Invited participants came from the business environment of Ferrovial. The workshop eventually attracted 44 participants in total of which 35 were external stakeholders with the professional capacities of architects, surveyors, building administrators, site personnel and designers. Figure 2 presents a screenshot of the online session. The tools were presented by their owners in English. Partners from Ferrovial made sure to clarify and translate in Spanish whenever needed. The feedback questionnaires were also translated in Spanish and sent to participants for gathering feedback. Questionnaire responses are available in ANNEX 1.

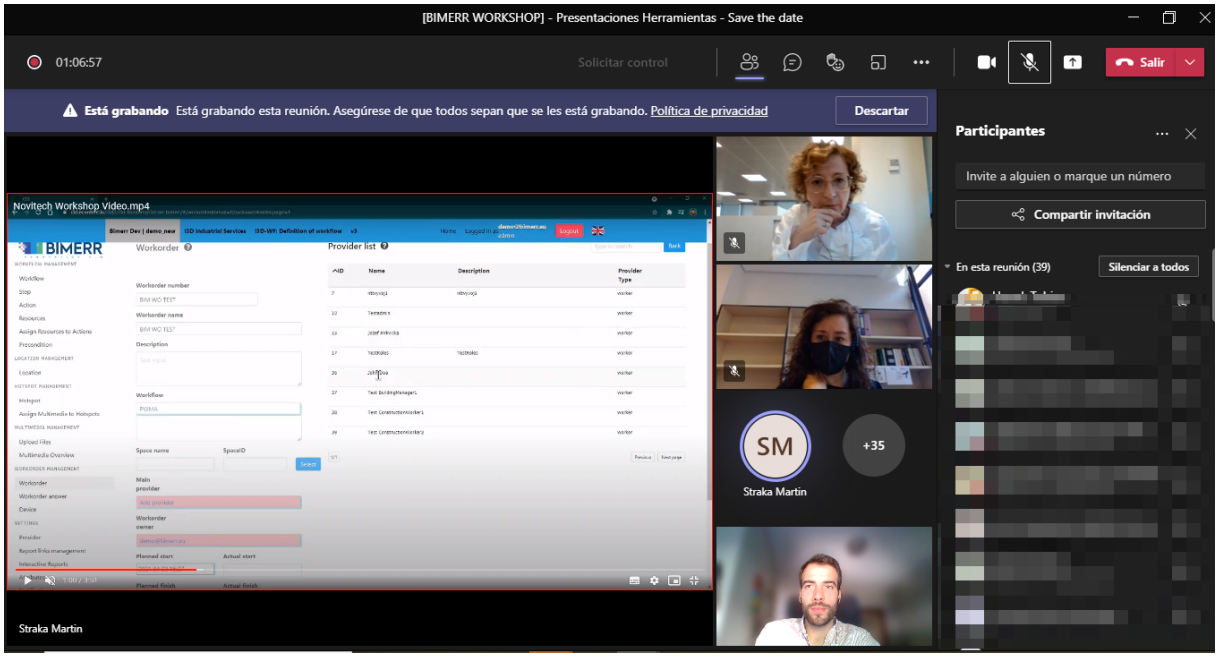


Figure 2 Screenshot of the online Living Lab workshop held for stakeholders in Spain

5.3.2 Online workshop for stakeholders in Poland

A similar format was followed for the workshop in Poland that was held on Wednesday June 2nd (M30) organized by BIMERR partner BUDIMEX. Invitations were sent to a broad range of contacts reaching 500 invitees. Nevertheless the number of participants that actually showed up and followed the workshop was deemed unsatisfactory since only 3 participants remained for the entire duration of the workshop. Furthermore, for this workshop, no feedback questionnaires were obtained. To mitigate this, it was decided to invite again stakeholders from Poland to attend the third workshop that was to be

organized soon after by CERTH (July, M31). According to the initial planning, this third workshop was dedicated to participants from Greece. Its online format together with the fact that all tools would be presented by their owner in English, lifted the restrictions of physical participation and language barriers which made possible to invite polish stakeholders as well.

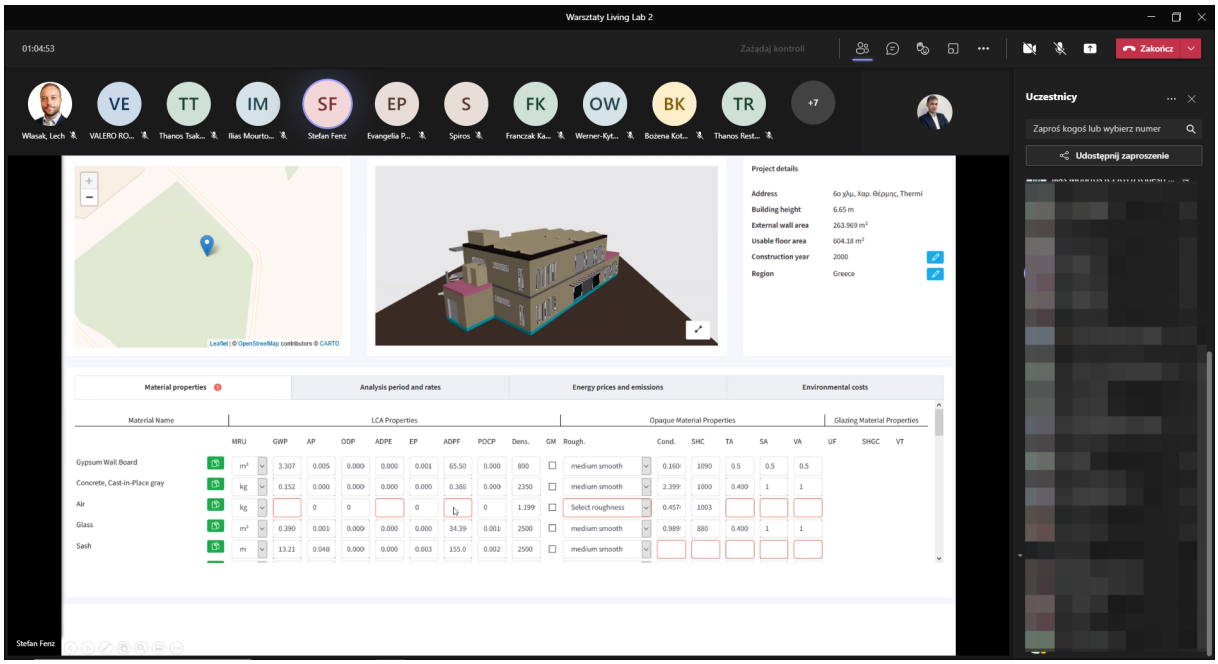


Figure 3 Screen shot from the Polish Living Lab held June 2nd 2021.

5.3.3 Online workshop for stakeholders in Greece

According to the BIMERR DoA, a third Living Lab workshop for stakeholders in Greece was planned to be implemented in this second round of Living Lab events. This workshop eventually took place on July 27th 2021 and was organized by BIMERR partner CERTH which among other tasks within BIMERR, is also responsible for one of the BIMERR pre-validation sites.

Pilot site partners BUDIMEX and FERROVIAL are enterprises directly involved in renovation projects. As such they have a large professional network that they could turn to in order to find participants for their respective workshops. In contrast, CERTH is a research institution established in Greece with no direct involvement in renovation projects. To tackle this and to make sure that the workshop would eventually attract sufficient participants, it was decided to create a social media campaign advertising the event. The campaign was shared among the BIMERR social media followers as well as the BIMERR partners that were also prompted to invite individuals from their respective business contacts that could potentially be interested in participating. To keep track of the subscribed users and to facilitate data exchange with them, an Eventbrite event was

created that users could freely subscribe and share. The total number of subscribed participants was 47. While their names cannot be made public by being reported here, the list with the institution from which they come from can be found in ANNEX 2. To gather feedback about the presented tools, a link to an online questionnaire was sent to all subscribed participants after the end of the workshop. The summary of their responses is available in ANNEX 3.

6. EVALUATION OF LIVING LAB WORKSHOPS

Up to month 32 of the project, three Living Lab workshops were foreseen to take place. According to the BIMERR DoA, the responsible partners were the pilot site owners (FER, BX) as well CERTH as the partner responsible for one of the pre-validations sites. As previously mentioned, due to the ongoing pandemic the workshops were eventually implemented using an online format and with certain delays compared to the initial planning. The online format that was used posed various difficulties in securing the appropriate audience both in regards to the total number of participants as well as in regards to their respective roles in the renovation pipeline. In this second round of Living Lab workshops, scope was to widely disseminate the project results and also give the opportunity to technology developing partners to request and receive feedback from potential end users regarding functionalities of the under development tools. In this context, the cumulative number of workshop participants to whom the BIMERR tools where presented can be deemed satisfactory. Furthermore, the end-user feedback received, will be reported and commented in this section.

The total cumulative number of external participants that attended the three workshops was 75. For the workshops in Spain and Poland, the contacts came from the professional network of these well-established construction companies. In the case of the Greek workshop that was organized by CERTH, to secure a satisfactory number of participants the event was advertised on all BIMERR social media platforms as well as through the social media accounts of the involved technology developing partners. The registered participants can be seen in a detailed list available in ANNEX 2. To gather data about the role of each participant in the renovation pipeline, a dedicated question in the relevant feedback questionnaire was added to deduce this information. The feedback questionnaires were sent to all participants right after each workshop together with a link to the respective recorded session in order for them to be able to go back to the workshop in case they needed certain information repeated before answering the online questionnaires. Of the 75 participants to whom the questionnaires were sent, 16 of them successfully replied to all questions and subsequently submitted the form. Their respective roles can be seen in Figure 4.

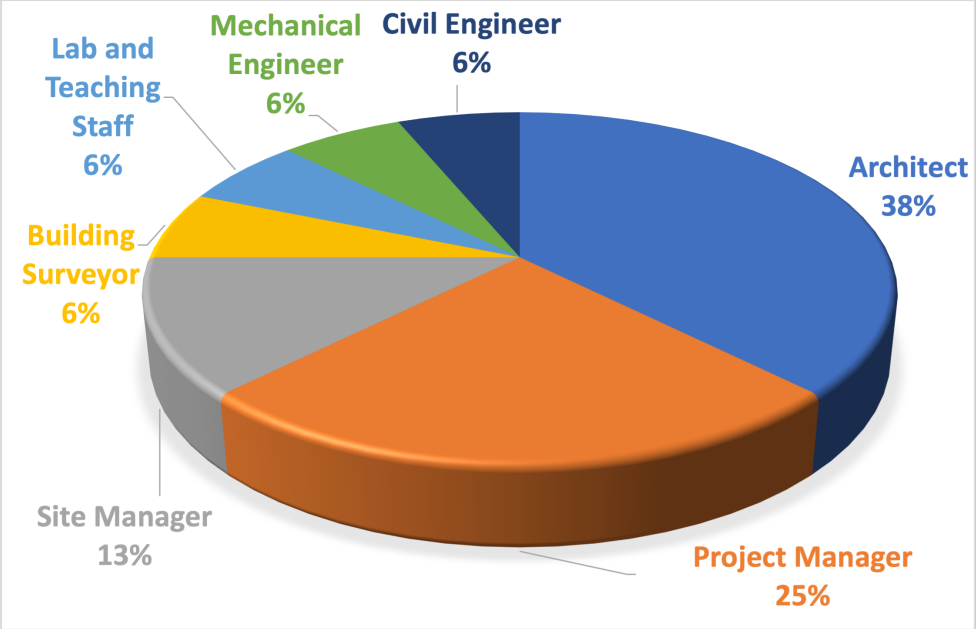


Figure 4: Living Lab Questionnaire role statistics

With these three workshops that took place under the predefined second round of Living Lab workshops, the relevant KPIs that were initially set in in D10.2 "Dissemination and Communication Plan" have been achieved. More specifically, at least 6 workshops were targeted by month 32 of the project, a metric that has been therefore achieved. Three more workshops are planned to take place by the end of the project which shall be reported in the third version of this document namely D10.8 "BIMERR Living Lab D10.8 activities evaluation report 3" due at the end of the project.

Regarding feedback on individual tools, the detailed responses of the participants are available in ANNEX 3. Certain recurring comments and responses that can offer valuable insights are mentioned below.

ARIBFA - Augmented Reality Enabled In-situ Building Feature Annotation

Localization accuracy as well as the accuracy of the BIM overlayed data on top of the actual building seemed accurate to most questionnaire respondents. Furthermore, most respondents find the ARIBFA application rather user-friendly. It was mentioned however, that the specific tool would definitely need to be used in real life conditions by a person in order for him/her to form a completely informed view about its usability. Showcasing its true usability via an online demo diminishes the capacity of the user to fully understand and comprehend its capabilities and subsequently identify ways it can improve his/her established everyday professional processes.

RenoDSS - Renovation Decision Support System

Regarding the feedback responses for this tool, interesting output was the fact that 90% of the respondents mentioned that in their ordinary line of work, they currently do not use IFC files in their renovation projects. Furthermore, no Life cycle assessment and/or Life Cycle Cost calculations are being made. These insights demonstrate the fact that currently most renovation processes do not rely on more modern ICT enabled solutions but instead rely more on previous professional experience and older established approaches such as calculation using excel or other similar software. Still however respondents expressed high interest in a tool that can provide various alternative renovation scenarios with such level of detail.

PWMA for Residents - Process & Workflow Modelling & Automation Toolkit

While most responses indicate that the application is considered rather user friendly and useful, respondents also mentioned that they would prefer to be able to use the application themselves before forming a definite view of its pros and cons.

UI for Project Managers App for on-site workers support - Process & Workflow Modelling & Automation Toolkit

Similarly, most responses indicate that the application is considered rather user friendly and useful. It was mentioned however that the tool, at least during the demo, did not seem particularly innovative unless its true usability is enhanced by the established and tested interoperability with other BIMERR tools in which case its usefulness might be increased.

7. CONCLUSIONS

In conclusion, deliverable D10.7 – "Living lab Activities Evaluation report" aims to describe all the implemented Living Lab actions performed in the BIMERR project until M32 of the project. As described in detail in the deliverable, the Living Labs activities are an important part of the BIMERR dissemination and exploitation strategy. In order to maximize the impact and the promotion of the BIMERR project results, the consortium uses a user-centric approach to incorporate all the user's needs and preferences to the final BIMERR result. Through this approach the use of Living Lab activities sets the end-user in the middle of the project's development. BIMERR Living Lab activities extend from the very first stages of project implementation (user requirements phase) up to the pilot evaluation phase, aiming at the establishment of an iteration and open collaboration process that will accelerate collaborative knowledge generation and integration, technology customization and validation against real market and user needs, as well as end-product definition and go-to-market strategy creation.

The objectives and the targets of the Living Lab activities, the methodology, the timeframe, the target groups as well as the implemented action by Month 32 of the project's lifecycle were described.

Due to the ongoing health crisis, various changes had to be implemented both in regards to the execution timeframe of the Living Lab workshops as well as in regards to the initially designed format. The targeted number of implemented workshops was however achieved and therefore the relevant key performance indicator (KPIs) fulfilled. From month 33 of the project and until its end, a third round of Living Lab workshops shall be implemented supporting the project's validation phase. The actions to follow shall be reported in the third version of the present document, namely D10.8 Living Lab Activities Evaluation Report 3".

8. ANNEX 1

Feedback questionnaires for Stakeholders in Spain

https://docs.google.com/forms/d/1Q0DoewiXxA62uZpPTRGSKf7jzz0DEU_4H7zc7WGvnb8 /edit#responses

Participants: 6

1A INGENIEROS, S.L.P. (Renewable gases and circular economy)
AH ASOCIADOS (AEC)
VIVIENDAS MUNICIPALES (Social housing promotion)
OBRAS ESPECIALES (Construction)
AMPMONEO (Architects and Innovation)
EMVS (Architects)

Tool Title: UI for Project Managers App for on-site (NOVITECH) – Herramientas de processos

Description: PWMA provides a set of tools to design, verify, simulate, execute, monitor and analyse the reconstruction process. It orchestrates the tasks of the re-construction process and provides UI for all the key stakeholders of the process to cover all phases of the reconstruction.

1. How would you rate the overall usability of the GUI in both applications?
   - "Handy, interactive and accessible"
   - "The tool is good as a "link" between office and construction site, nevertheless it would be interesting to see in future presentations what are the differences with other existing tools"
   - "Good"
   - "Good"
   - "Would need to use it"
   - "Good"

2. What information would you suggest to get highlighted or more dominant?

   We would suggest creating a link to information about materials, if available
   None
   None
   "Would need to use it"
   "Would need to use it"

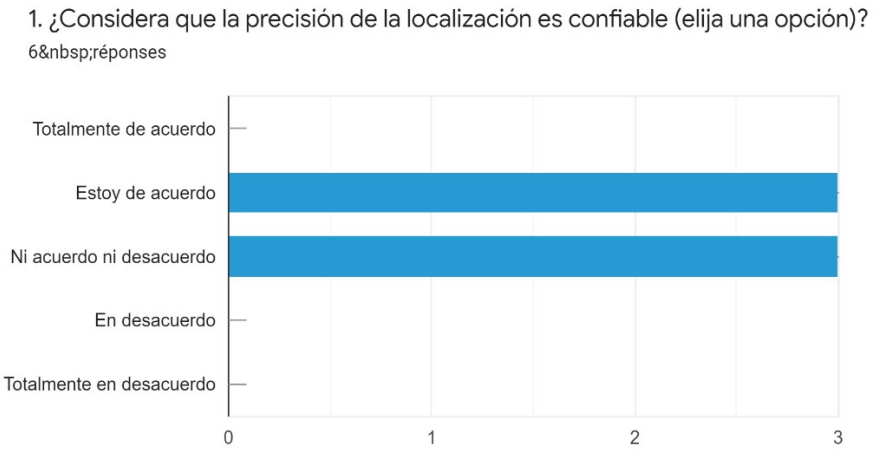
3. Are the upper notifications in the Viewer visible enough?
   - Yes, visible enough
   - I did not pay attention during the presentation
   - Yes, visible enough
   - Yes, visible enough
   - "Would need to use it"
   - Yes, visible enough

4. Are the field names in Manager Tool clear enough, or should we provide some further explanation/hint to each one?
   - Yes, they are clear, perfectly understandable
   - I did not pay attention to that point in the presentation
   - Yes, they are clear
   - "Would need to use it"
   - It is always better to have explanatory notes
5. Would you add any additional information to the Flow diagram in the Manager Tool?
   - No
   - Maybe the impact that a delay/lag has
   - NO
   - no
   - "Would need to use it"
   - "Would need to use it"

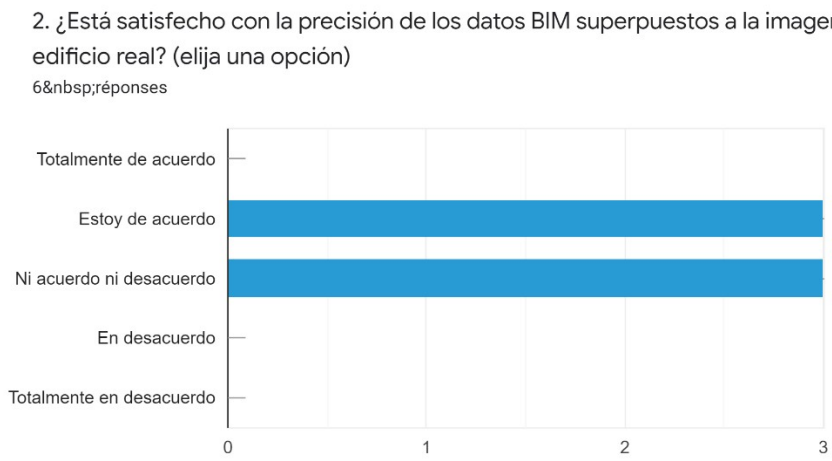
Tool Title: ARIBFA - AUGMENTED REALITY ENABLED IN-SITU BUILDING FEATURE ANNOTATION (CERTH) - Herramientas de ayuda en obra (Hololens – gafas intelingentes)

Description: The ARIBFA tool will be responsible for presenting BIM 3D visualisations and spatially annotated information on site during the renovation process to architects, contractors and building managers through an Augmented Reality (AR) interface. The main functionalities covered by ARIBFA involve the localization of the user in an indoor environment, based on which will be overlaid on top of the physical location of the building. Using object recognition methodologies, elements to be changed or worked upon during the renovation will be highlighted in the AR visualization, as well as Health and Safety annotations and designated work areas as defined in the daily work schedule.

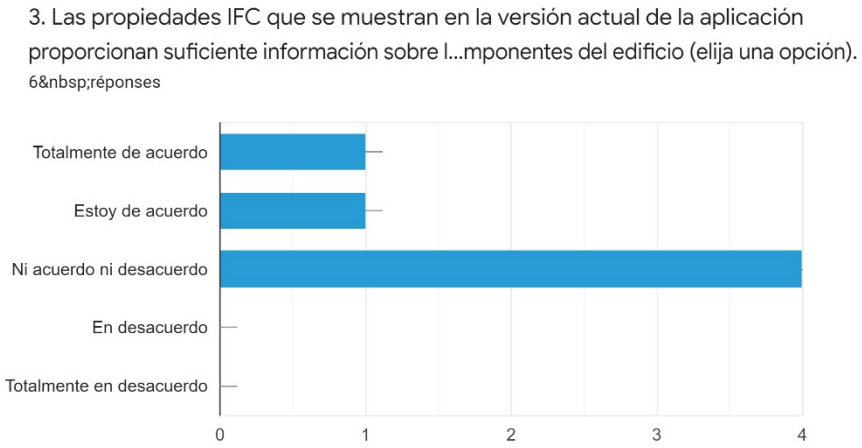
1. Do you find the localization accuracy reliable? (please choose)



2. Are you satisfied with the accuracy of the BIM overlayed data on top of the actual building? (please choose)

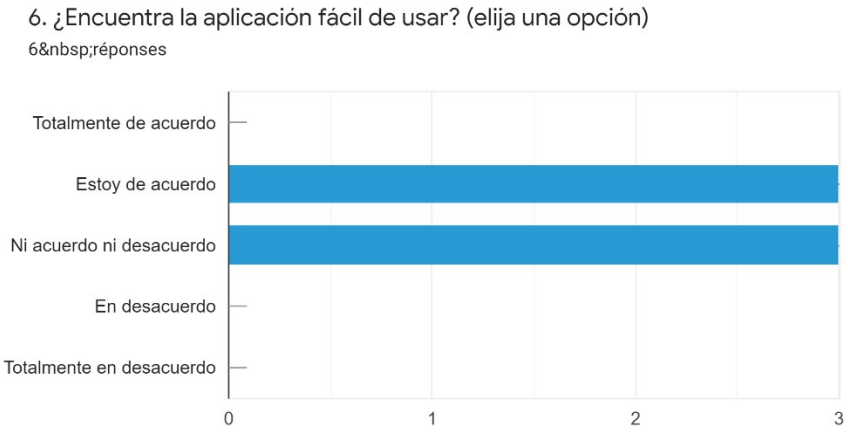


3. Do the ifc properties that are currently visualized by ARIBFA GUI provide sufficient information regarding the building components? (please choose)



4. Are you satisfied with the way in which you add annotations? If not, what would you change in this segment?
    - The overall tool is useful and Handy, nevertheless, adding an annotation seems rather slow
    - Apparently easy
    - Yes
    - Yes
    - “Would need to use it”
    - “Would need to use it”

5. Are you satisfied with the way in which you are informed about tasks? If not, what would you change in this segment?
   - Satisfied
   - Agreed
   - Yes
   - Yes
   - “Would need to
   - “Would need to
6. Do you find the ARIBFA application user friendly? (please choose)

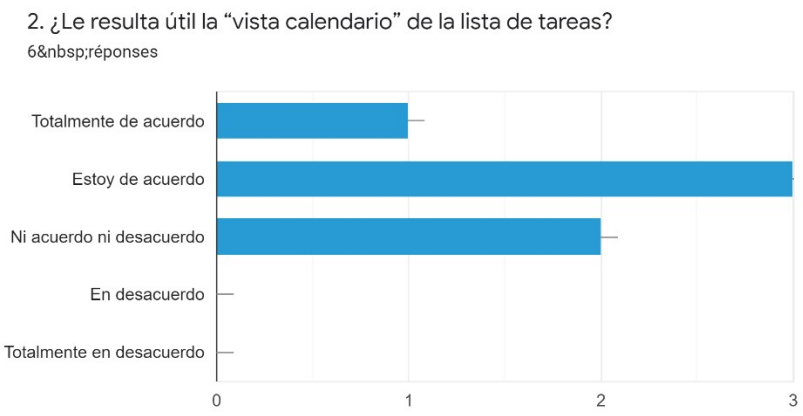


7. Do you find any functionality difficult to use or follow? If so, please list the specific parts.
   - Seems rather complex
   - Seems easy to use
   - “Would need to use it”
   - Yes, rather complex
   - “Would need to use it”
   - “Would need to use it”

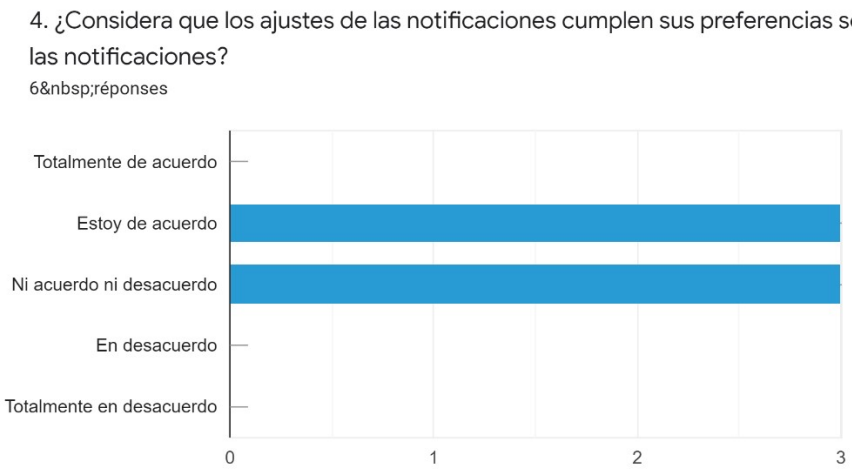
Tool Title: PWMA for Residents (CERTH) – Herramientas para involucrar e informar a los residentes (Nivel de “satisfacción” de cara a: Interfaz visual, Usabilidad, ¿Todas las funcionalidades son útiles? La manera de recibir notificación o reportar incidencias, ¿Algunas dificultades?)

1. Do you need more information about the tasks? If so, please mention them.
   - No
   - Seems adequate
   - NO
   - No
   - “Would need to use it”
   - “Would need to use it”

2. Do you find the "Calendar View" of tasks's list usefull?



3. Are you satisfied with the way in which you comment on the tasks? If not, what would you change in this segment?
    - It is Good, but I would include an “accessibility mode”, with bigger letter and audios
    - Apparetnly adequate
    - Yes
    - Yes
    - “Would need to use it”
    - “Would need to use it”
4. Do you think that the Notifications Settings cover all your preferences about the notification

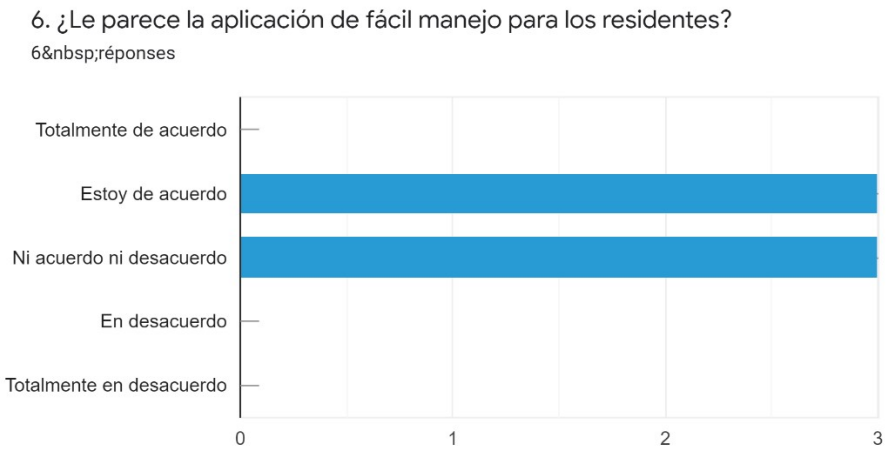


5. Are you satisfied with the way in which you report the issues? If not, what would you change in this

The overall tool is useful and friendly, nevertheless, adding

- Seems adequate
- Seems adequate, I find that ading pictures and videos is a good idea
- Yes
- Yes
- “Would need to use it”
- “Would need to use it”

6. Do you find the PWMA For Residents application user friendly?



- Seems rather complex
- No, it is easy with clear interface
- No
- None
- None
- "Would need to use it"
- "Would need to use it"

Tool Title: RenoDSS (Xylem) – Herramientas de ayuda a la toma de decisión

3. Which BIM tools are you using in your daily work?
    - Revit
    - All plan / Revit / Dynamo
    - None
    - -
    - Open
    - Revit, Naviswork, own Database

Description: RenoDSS provides an accurate estimation of the energy, cost, and envi-ronmental impact trade-offs of alternative renovation scenarios. The esti-mation of post-renovation energy consumption is based on energy data models, structural and geometrical properties of the building, materials, HVAC systems, residents' usage profile, as well as weather data. RenoDSS also takes the environmental impact of the renovation and the interaction with surrounding buildings into account. All KPIs and details of possible renovation scenarios are shown in an intuitive user interface which enables the renovation designer to select the optimal renovation scenario in terms of costs, energy consumption, and environmental impact.

1. What is your job description?
    - Circular economy.
    - Investigation/Innovation
    - Social housing promotion and renovation
    - Building administrator
    - Architectural projects
    - Implementing BIM tools in the company, Support to other divisions in the energy efficiency processes, standardization and quality control
2. How much (%) of your projects are based on IFC files?
    - 0 %.
    - In production, almost no use of IFC files
    - 0 %
    - -
    - Half of them approximately
    - 5%
4. Which tools do you currently use for building energy performance estimation (e.g., TEE-KENAK)?
    - Nothing specifically
    - Spanish standard, which is HULC
    - None
    - -
    - Unified tool
    - N/A
5. Which tools do you currently use for LCA/LCC calculations?
    - None
    - Fort he time being, none
    - None
    - -
    - N/A
    - N/A
6. How do you currently identify potential renovation scenarios for a given building?
    - No me dedico a la edificación
    - Based on the Experience of the lead Architect of the project
    - Analisis of the ITE (energy Audit) and other report + onsite inspections
    - -
    - Depends on each case
    - N/A

It can be useful especially for the estimation of energy efficiency
The main advantage is to evaluate LCA and LCC of different renovation scenarios with reliable data
Depends on the typology of Project and on the specific requirements from each project
"Would need to use it"
N/A

- How can your field of work profit from RenoDSS (building material database, energy performance estimation, LCA/LCC calculation, renovation scenario generator, reporting)?

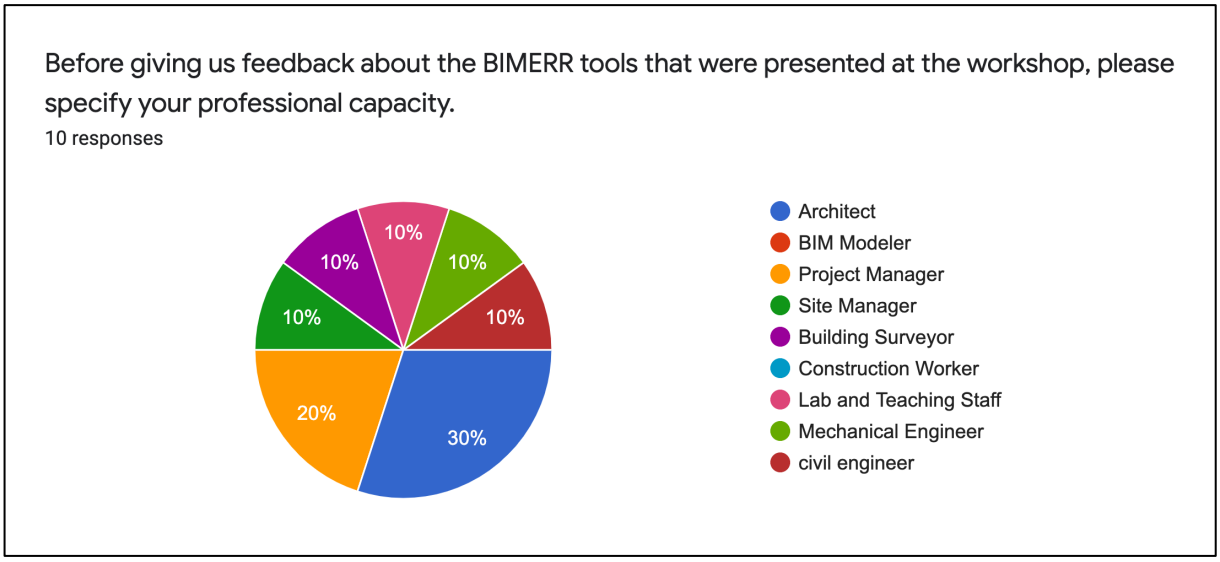
9. ANNEX 2

Order no.	Company
1796347675	University of waterloo
1796425387	Quartermile Developments
1796499093	Institut für Baumanagement & Digitales Bauen - Universität Hannover
1796520383	Atcon
1797235853	Everest 5
1797354907	ITI/CERTH
1797390289	Leonidas Nassis Passive House Design
1797392437	Darktarce
1797404003	Budimex SA
1797481079	Budimex SA
1797553361	ISZEB DIH
1797719841	IsZEB
1798266443	Box
1798270217	Budimex S.A.
1798351503	Budimex SA
1798406405	AUTH
1798536461	Aristotle University of Thessaloniki
1798844903	National Technical University of Athens
1799348883	University
1799430941	Agroland S.A.
1799478401	Freelance
1799787661	Walldone
1799900811	Budimex
1800359497	Currie and Brown
1800832461	GTCORALLIA
1800960627	Parametrix
1801183597	CCCC
1801763467	CERTH/ITI
1801763523	CERTH/ITI
1801768585	ARCH-DUTH
1801815539	CERTH/ITI
1801849785	MC-CHARGERS
1801863841	MERIT

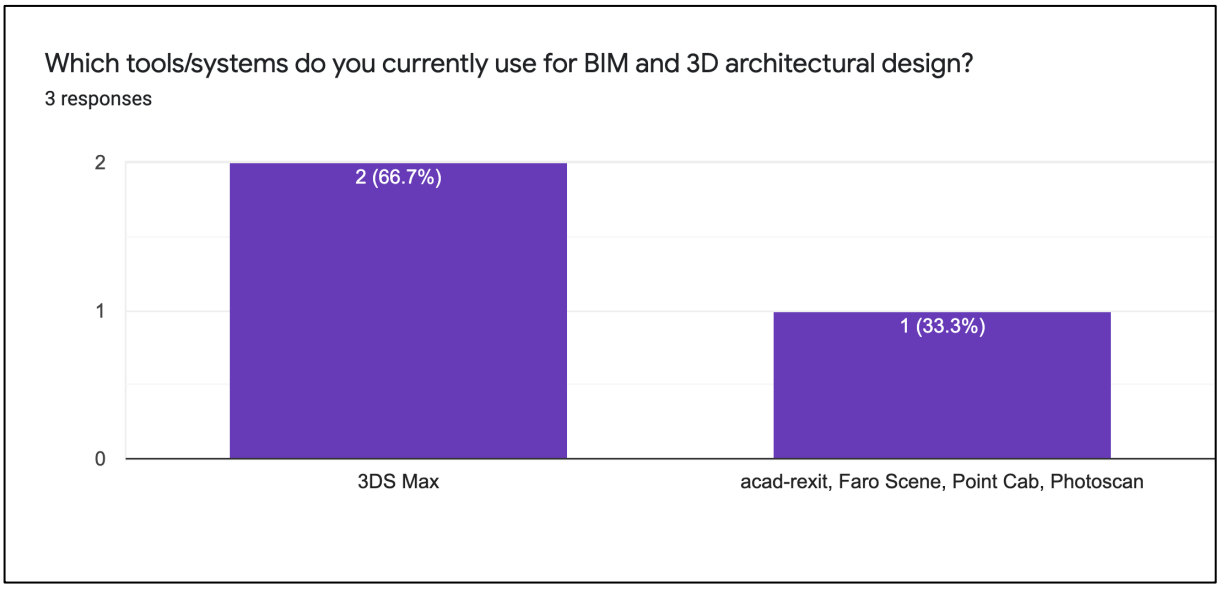
1801864763	BUDIMEX S.A.
1801864817	Budimex S.A Poland
1801886591	Budimex SA
1801890713	Fraunhofer FIT
1801894583	certh- iti
1801940993	Budimex S.A.
1801958211	Budimex S.A.
1801975115	BUDIMEX S.A.
1802727571	Budimex
1802764865	CERTH
1802775301	La Salle BCN
1802783635	ZGN Praga-Południe
1802786983	Budimex
1802813263	CERTH

10. ANNEX 3

Responses to feedback questionnaire by participants of the Living Lab organized by CERTH



BIMERR Tool #2: ARIBFA - Augmented Reality Enabled In-situ Building Feature Annotation



What are the main data formats that you use to import to these systems?

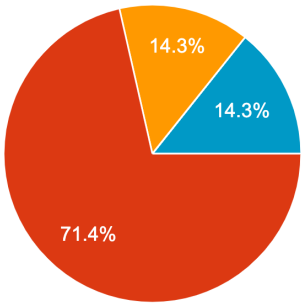
*fls, *psx,

What formats do you export to using these systems?

DWG

The localization accuracy is reliable?

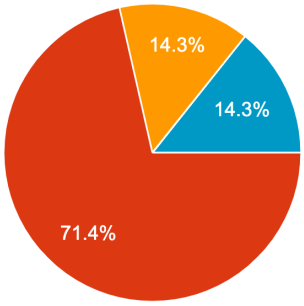
7 responses



- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- I would have to use the tool first to verify its accuracy. However I am not convinced that the tool solves more problems that it creates.

I am satisfied with the accuracy of the BIM overlayed data on top of the actual building.

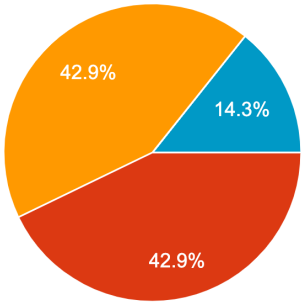
7 responses



- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- I would have to use the tools to give an accurate response

The IFC properties that are currently visualized by ARIBFA GUI provide sufficient information regarding the building components.

7 responses



- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- I am not sure before using it

Are you satisfied with the way in which you add annotations? If not, what would you change in this segment?

6 responses

yes

I AM NOT COMPLETED SATISFIED BUT I HAVE NOT A SUGGESTION

Looks a bit complicated but I would get used to it

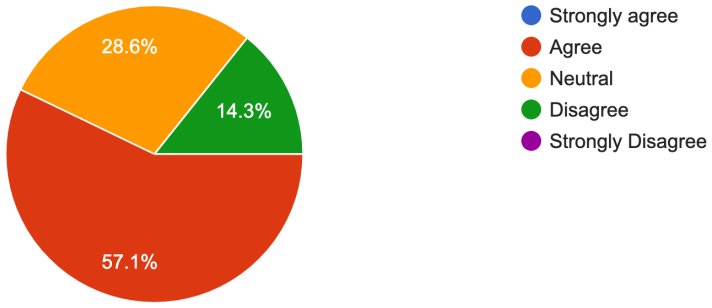
YES

I would need to use it myself

looks like the overall systems lags and is a bit slow

I find the ARIBFA application user friendly?

7 responses



Do you find any functionality difficult to use or follow? If so, please list the specific parts.

3 responses

ICANNOT ANSWER SINCE IHAVE NOT USE IT

NO

I do not understand how it can be really usefull

BIMERR Tool #3: RenoDSS - Renovation Decision Support System

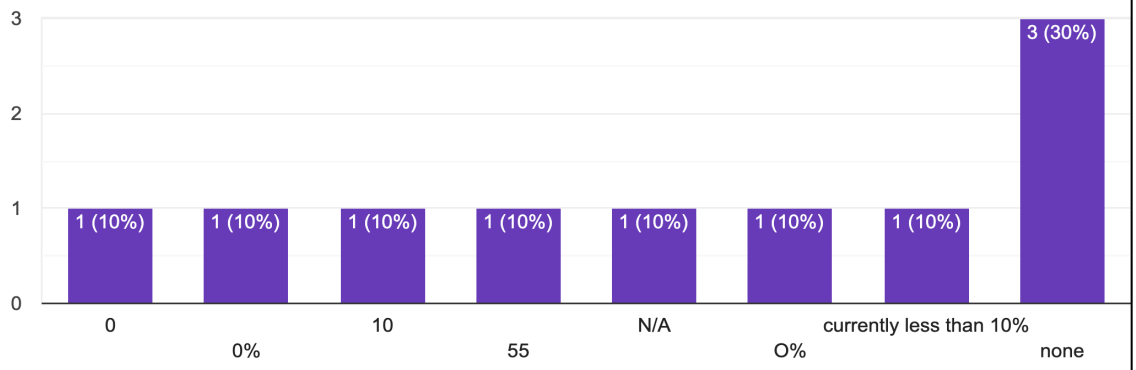
What is your job description?

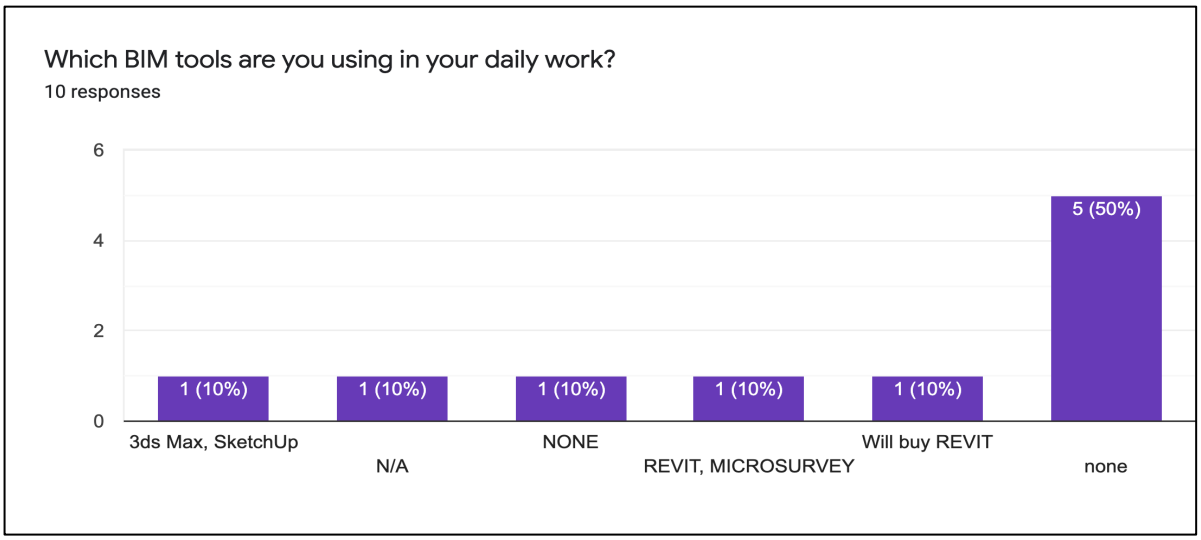
10 responses

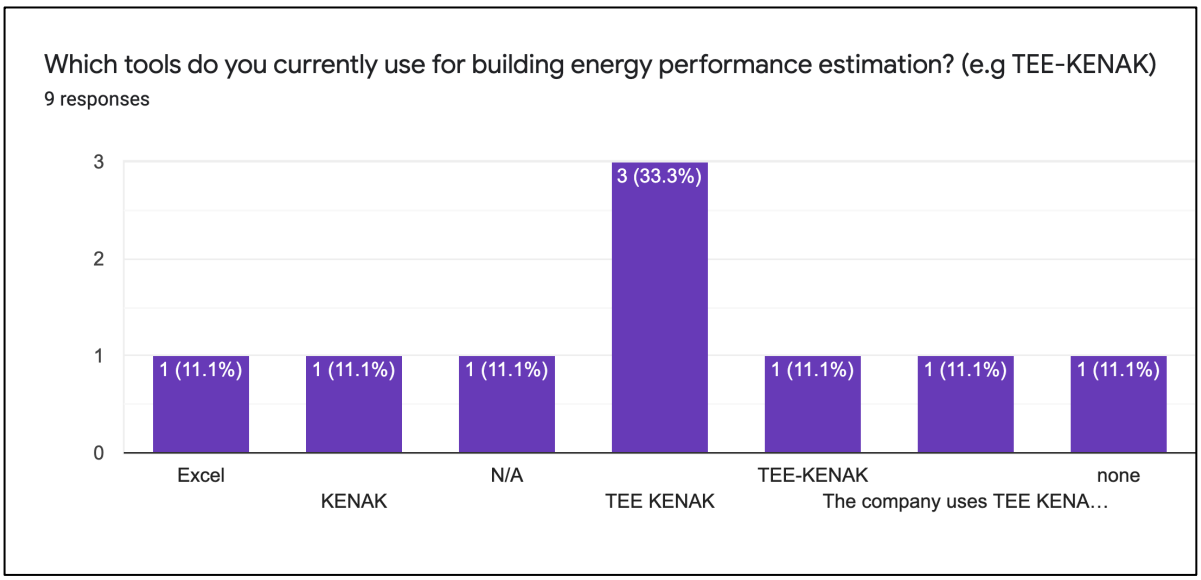
- Energy Auditor, EPC Assessor, Design Engineer
- CIVIL ENGINEER SPECIALIZED IN MATERIALS AND REPAIR WORKS
- Architect, Heritage Studies
- Renovation engineer
- CHIEF SURVEYOR ENGINEER
- Civil engineer, constructions
- 3D Designer for renovation projects
- Construction Site supervisor
- Renovations Architect

How much (%) of your projects are based on IFC files?

10 responses

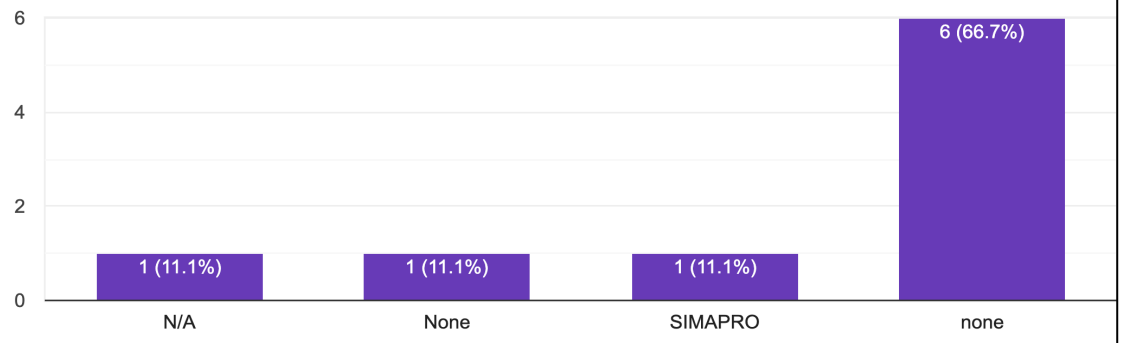



Which BIM tools are you using in your daily work?
10 responses
6
4
2
0
1 (10%)
1 (10%)
1 (10%)
1 (10%)
1 (10%)
5 (50%)
3ds Max, SketchUp
N/A
NONE
REVIT, MICROSURVEY
Will buy REVIT
none


Which tools do you currently use for building energy performance estimation? (e.g TEE-KENAK)
9 responses
3
2
1
0
1 (11.1%)
1 (11.1%)
1 (11.1%)
3 (33.3%)
1 (11.1%)
1 (11.1%)
1 (11.1%)
Excel
KENAK
N/A
TEE KENAK
TEE-KENAK
The company uses TEE KENA…
none

Which tools do you currently use for Life cycle assessment (LCA) and life cycle cost (LCC) calculations?

9 responses



How do you currently identify potential renovation scenarios for a given building?

9 responses

N/A

By using excel calculations and TEE KENAK

BASED ON EXPERIENCE FROM PRACTICE.

searching

based on client budget and obligations by the law

manual calculations

working experience and project budget

based on the project budget

Client budget

How can your field of work profit from RenoDSS (building material database, energy performance estimation, LCA/LCC calculations, renovation scenario generator, reporting)?

8 responses

Students can realise the benefits of BIM application in the entire Life Cycle of a construction

It provides an end - to end solution that saves time and improve efficiency of parties involved

RenoDSS WILL MUCH FACILITATE TO ADOPT THE MOST PROFITABLE SCENARIO IN SHORT TIME.THE MOST PROFITABLE RENOVATION SCENARIO PROVIDED THAT RELIABLE DATA HAVE BEEN USED AND CERTIFICATION SYSTEMS FOR MATERIALS AND DEXTERITIES ARE FOLLOWED IN CONSTRUCTIONION ABOUT

fair

The energy performance estimation would most probably be the most useful tool. As however in greece, permits need to be validated using the state approved software, I would probably hesitate to invest in buying it.

erenovation scenario generator could greatly save time in evaluating renovation options

maybe the renovation scenario generator could help but aesthetics play also a significant role in my line of

renovation scenario generator could be useful but seams there is a learning curve before using it

BIMERR Tool #4: PWMA for Residents

Do you need more information about the tasks? If so, please mention them.

6 responses

YES

yes

Looks sufficient

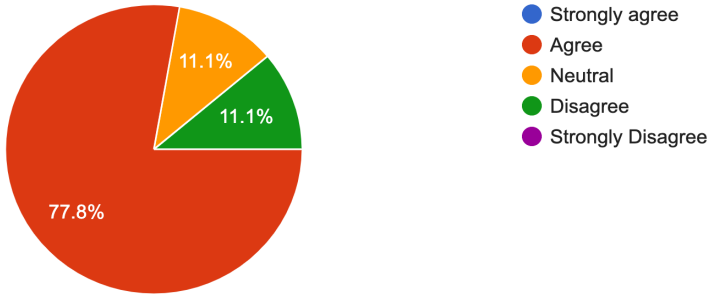
I am not sure how this application could be useful as building residents are usually evacuated before a renovation

In my projects there are no residents in the building

No

The "Calendar View" of tasks' list is useful

9 responses



Are you satisfied with the way in which you comment on the tasks? If not, what would you change in this segment?

3 responses

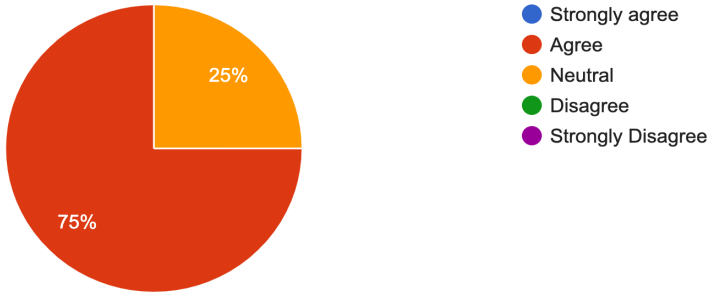
AFTER THIS FIRST PRESENTATION IT IS DIFFICULT TO HAVE AN ANSWER TO MANY QUESTIONS

YES

Satisfied

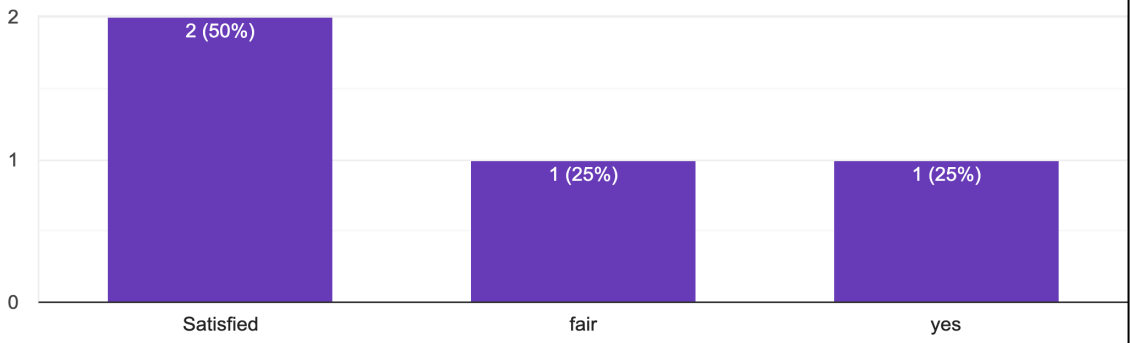
The Notifications Settings cover all your preferences about the notifications.

8 responses



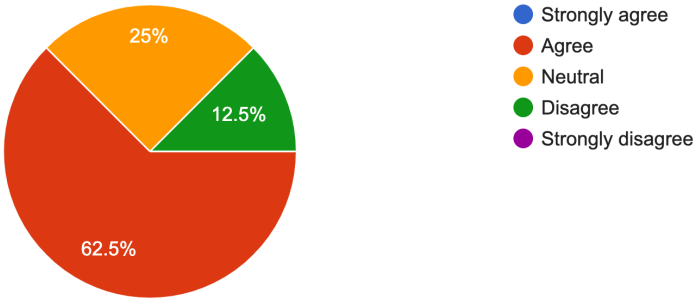
Are you satisfied with the way in which you report the issues? If not, what would you change in this segment?

4 responses



PWMA For Residents application is user friendly.

8 responses



BIMERR Tool #5: UI for Project Managers App for on-site workers support - Process & Work-flow Modelling & Automation Toolkit

Would you add any additional information to the Flow diagram in the Manager Tool?

5 responses

- probably
- No
- NO
- YES
- yes

What information you would suggest to get highlighted or more dominant?

6 responses

- the user could choose from a list according to his interest
- VERIFICATION ,EXECUTION,MONITORING
- more info
- I cannot make a suggestion
- I would need to use it to give better recommendations
- no suggestion

Are the field names in Manager Tool clear enough, or should we provide some further explanation/hint to each one?

6 responses

yes

further explanation/hint needed

Yes

YES

I cannot comment

no

How would you rate the overall usability of the Graphical User Interface (GUI)?

6 responses

Good

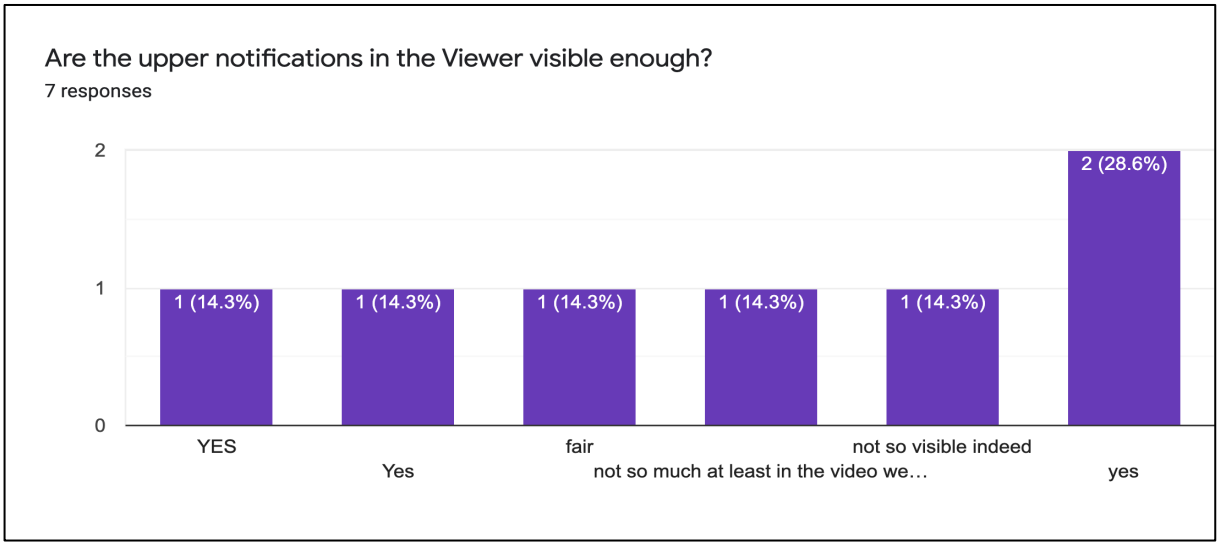
fair

It looks good

it looks a bit boring. I do not understand which is the innovative part in this. There a several similar tools in the market. Maybe its interoperability with the other BIMERR tools makes it good but I would need to see them working together

Alright

good


Are the upper notifications in the Viewer visible enough?
7 responses
2
1
0
1 (14.3%)
1 (14.3%)
1 (14.3%)
1 (14.3%)
1 (14.3%)
2 (28.6%)
YES
Yes
fair
not so much at least in the video we…
not so visible indeed
yes