xR4DRAMA

Extended Reality For DisasteR management And Media planning

H2020-952133

D6.4

Final system evaluation

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Abstract

This deliverable describes the methodology, process, and results of the evaluation of the final xR4DRAMA prototype.

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History

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Executive Summary

This deliverable describes the evaluation results of the final xR4DRAMA prototype from the end users' perspective based on the outcomes of two pilots (media planning PUC in Corfu and Berlin, March 2023, and disaster management PUC in Vicenza, 7-8 March 2023). During those occasions, the main stakeholders of the two developed use cases (media production planning and disaster management) tested the xR4DRAMA platform in the context of their scenarios, providing feedback focused on effectiveness, efficiency, and user satisfaction.

Describing more in detail the contents of this document, the first section of the deliverable provides a short summary of the functionalities of each xR4DRAMA tool developed for the final prototype and tested during the pilots.

Then, the deliverable starts to describe the pilots' structure, their context and organization, focusing on the evaluation of the final system from the perspective of the end users who participated in the pilots as active players. Feedback from the users was collected both during the pilots and after. These data had been analysed with the procedure described in the final part of this deliverable, which provides also the results emerged from the evaluation.

Abbreviations and Acronyms

AT	Authoring tool
AR	Augmented Reality is an immersive technology superimposing layers of digital content into the physical world to enhance the user's real-world experience
DSS	Decision Support System
IMUs	Inertial Measurement Units
POIs	Points Of Interest
PUC	Pilot Use Case
SA	Situation Awareness
VR	Virtual Reality
WP	Work Package
XR	Extended Reality also known as cross-reality and hyper-reality, is an umbrella term that encompasses human-machine interactions generated by computer technology with devices or wearables to create real and virtual environments which include VR and AR
6DoF	Six Degrees of Freedom

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1 INTRODUCTION

This deliverable describes the evaluation of the xR4DRAMA final prototype. In addition, the deliverable provides, in the first part, an overview of the final system describing the modules and tools developed and tested in the field, while in the second part the concerns about the implementation of the two pilots, PUC1 in Vicenza and PUC2 in Corfu and Berlin. The platform, in fact, needed to be tested in real life conditions, which had been demonstrated through the two-xR4DRAMA pilots and evaluated based on the interaction with the technology. This allowed the consortium to gather precise feedback and indications from the end user's prospective as results of the evaluation.

2 XR4DRAMA FINAL SYSTEM

2.1 Data acquisition from Web and Social Media

The data acquisition module is a fully-fledged solution that can collect multimedia from multiple heterogeneous Web and social media resources. It uses several different techniques to extract textual and high-quality audio-visual content that is freely available on the Internet and provide it to the xR4DRAMA platform.

The activities for the first prototype version involved designing the module's architecture and implementing various methodologies for discovering and extracting online content from the open Web and social media platforms such as Twitter and Youtube. Moreover, a unified data model, an extension of the SIMMO[1] one, was utilized to represent and store the various types of multimedia.

In the second development cycle, this module was upgraded so that Twitter platform can be searched in its entirety using the V2 API. Also, data collection was enriched with more online sources. Specifically, it now supports retrieval of Wikipedia articles, multimedia from Flickr, forum threads from Reddit, points of interest from Foursquare and archives from Deutsche Welle. In addition, this module now supports the integration of all types of citizen reports (text, audio, video, image), which are converted into the SIMMO data model before storage. SIMMO was modified and further extended in the second cycle to capture the information in all these new resource types and to retain the ability to store heterogeneous data in a unified format (as described in Deliverables D2.2 and D2.5). Lastly, the exposed APIs have been updated to allow only authorized services to connect using encrypted communications.

[1] https://github.com/MKLab-ITI/simmo

2.2 **Physiological and environmental data acquisition module**

2.2.1 **The physiological data acquisition module – Disaster Management use case**

As a result of the first pilot in Vicenza (PUC1) the wearable sensing platform composed of a smart vest and a data logger can acquire physiological signals and monitor users' activities. The acquired data are integrated into the xR4DRAMA platform using the Citizen App, in a secondary mode intended for First Responders, which collects the physiological data and data coming from the IMUs (Inertial Measurement Units), integrated on the data logger to detect the movement of the user's body in real-time.

To make the smart vest more suitable to be worn under the uniform of Civil Protection Volunteers, minor changes on the model design have been made. Indeed, the new model appears more low-cut at the level of the neck and armholes than the initial version of the vest. Moreover, a selection from several technical fabrics have been done and it was selected a Sensitive® fabric as its open honeycomb structure increases the breathability and the tri-dimensional elasticity made with a high percentage of LYCRA® elastic fiber allows for perfect freedom of movement. Instead, no further changes have been made to the sensing part which includes the two textile electrodes and a textile respiratory motion sensor as the sensing system works properly.
Five tailored systems (4 for male and 1 for female) were produced and provided to the team of Civil Protection volunteers. Furthermore, a new production of data loggers (RUSA device) has been made upgrading the power consumption management and optimizing signal filtering.

Figure 1: The new smart vests

The improved wearable sensing platform has been tested during the 2nd pilot held in Vicenza.

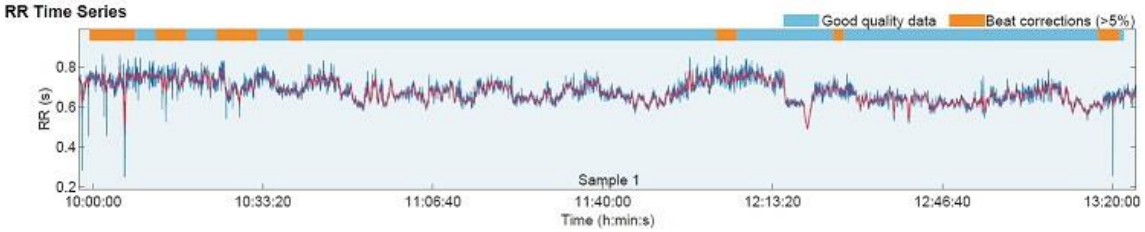


Figure 2: RR interval extrapolated from the ECG signal, signal quality analysis (data recorded during the pilot)

Sample limits (hh:mm:ss)	09:57:17-13:24:41
Sample Analysis Type	Single sample
Beat correction	Automatic correction
Beats total	18500
Beats corrected	545
Beats corrected (%)	2.94
Effective data length (s)	12444
Effective data length (%)	100

Table 1: ECG signal quality results

Data acquired have been analysed with a commercial tool for signal analysis, that provides an automatic filter to remove ECG signal artefacts. On the whole signal with a duration of 3h 22m, on a total beat detected of 18500 only 545 beats have been corrected, the 2.94% of the whole signal.

2.2.2 **The environmental data acquisition module – Disaster Management use case**

The wearable device to monitor local water pressure was designed and produced. The device is composed by two small pressure sensors able to detect the local hydrodynamic pressure in the flooded area in which the first responder operates.

The device is a proof of concept based on the need to assess people's vulnerability with more accurate data. In fact, in this scenario, the flooded area with a low-depth of water and a high-velocity of the water flow are considered very dangerous as demonstrate in a study2 that describes how human instability can be related to two physical mechanisms: the momentum (overturning) and friction (slip) instability.

In emergency conditions, the first responders are called to explore flooded areas for which the velocity and depth of the water are not easily to estimate, except with a portable instrumentation.

[2] Jonkman, S.N. and E. Penning-Rowsell (2008), Human Instability in Flood Flows, Journal of the American Water Resources Association (JAWRA) 44(4):1-11. DOI: 10.1111/j.1752-1688.2008.00217.x

Moreover, to ensure a prompt intervention in an emergency, the operator has to be facilitated in acquiring the required information using instrumentation that is not bulky and is easily usable. The velocity of water flow (v) is obtained from the hydrodynamic pressure values using the formula shown in Figure 3. Furthermore, the depth of water (h) is obtained by fixing the device at ankle level to fix the height of the device and consequently know the depth of the water knowing the water pull.

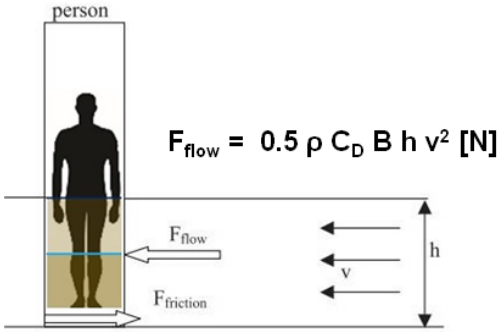


Figure 3: Correlation between the Water-flow Force and Depth of flood water (h) and Velocity of flood water (v)

The device is waterproof by adding sealing silicone at the level of the closure, having to leave the device box openable in case of small changes during the study phase. Indeed, some issues in data transmission via Bluetooth have been noticed when the device is in the water. To ensure data transmission for depths greater than 10 cm in water, a flexible antenna has been integrated.

The wearable pressure system has been tested in the laboratory and an unexpected issue with the zero-pressure reading occurred: each sensor has its own offset, and this wasn't indicated in the data sheet. With the aim to solve this issue, several measurements in the air and in the water have been made with the aim to find a common calibration curve. The final equation was entered into the firmware to read the pressure values from the sensors.
Anyway, a calibration phase must be carried out before the acquisition in the water: the device will be used by acquiring the pressure sensor values on the air for at least 1 minute. The mean of these values for each channel has to be subtracted with the aim to the detected pressure values one time the device is in the water.
The experimental protocol was done by submerging the device in 20 cm of static water and the pressure values of each channel was compared with the hydrostatic theoretical pressure value that is calculated by using the Stevin formula (P= r*g*h, r: density of the liquid, g: acceleration of gravity, h=depth of water) for h=13 cm.

Figure 4 shows the results: the hydrostatic pressure values of channel 65 (sensor 1, yellow line) are almost close to the theoretical with an average percentage error of 1.53%; instead for channel 64 (sensor 2, red line) the average percentage error is of 4.2%.

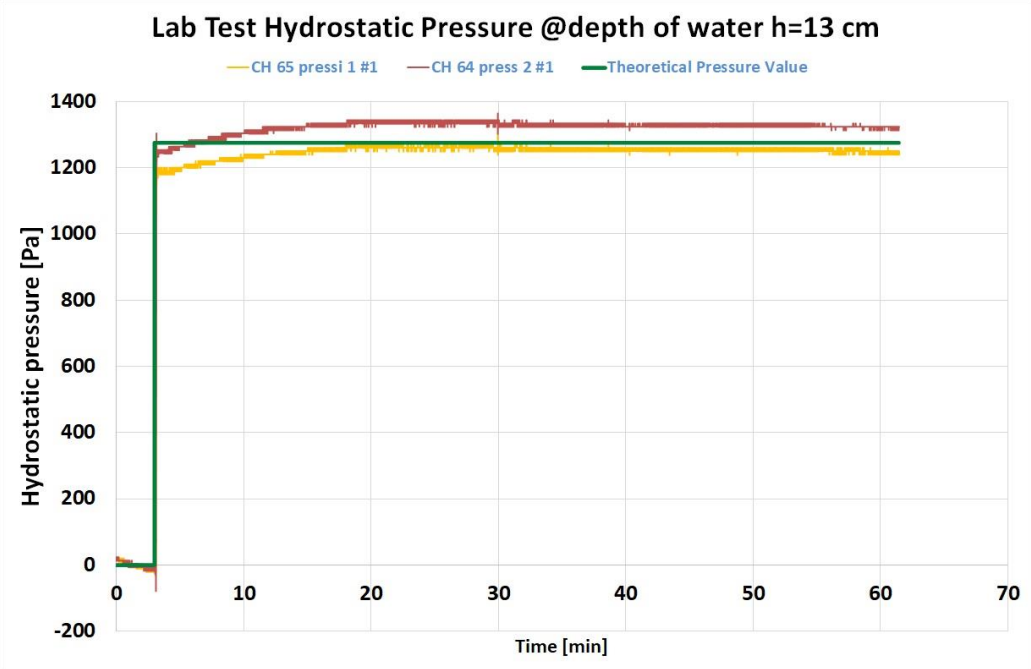


Figure 4: Hydrostatic pressure values of sensor 1 and 2 compared with the theoretical hydrostatic pressure value

The wearable pressure device has been tested also in the field to evaluate its usability and acceptability, and the results were positive.

In Figure 5, the acquired signals show the behaviour of velocity of water flow measured in proximity of first responder: sensor1 reads the values of water flow in front of the user, instead the sensor 2 detects velocity on the back direction.

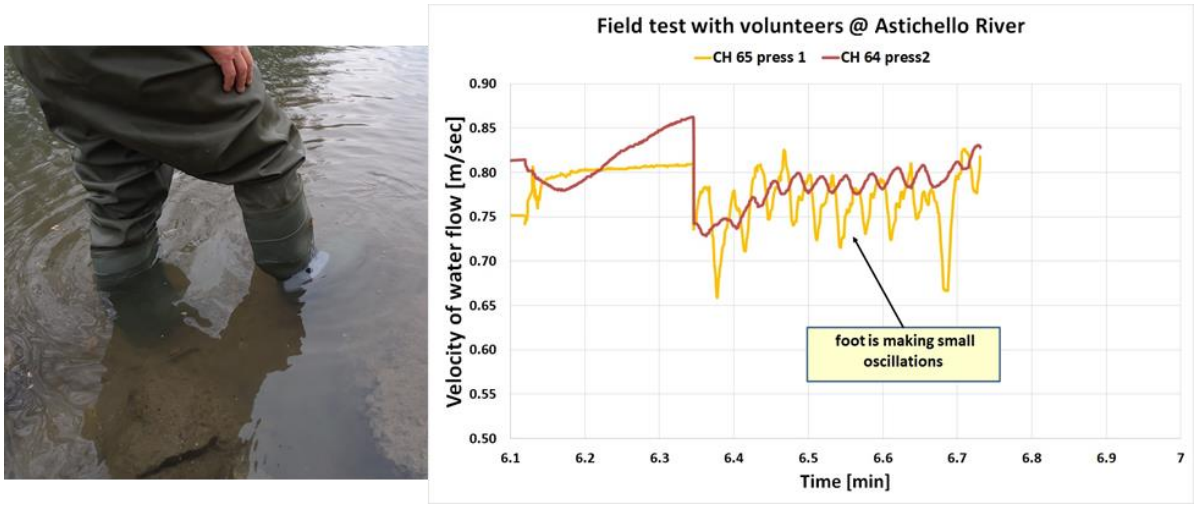


Figure 5: On the left, the First Responder wears the wearable pressure device; on the right, the elaborated data show the behaviour of water flow velocity

2.3 **Sensor Data Analysis and stress level fusion**

The sensor-based stress level detection is based on the analysis of the data received from the smart vest in order to predict the stress levels of first responders in real time. Through the acquisition of the physiological signals of the first responders from the smart vest and the corresponding analysis, the stress levels of the first responders can be monitored continuously in real time. During the 2nd period of xR4DRAMA, the module was evaluated using results from the two pilots.

Results from the 1st pilot can be seen in Figure 6. In the Figure, each subfigure depicts the stress over time for one subject, where the x-axis is time, and the y-axis is the stress level. During the 1st pilot, the stress levels across all subjects are at medium levels which is a reasonable result since there was no real stressor.

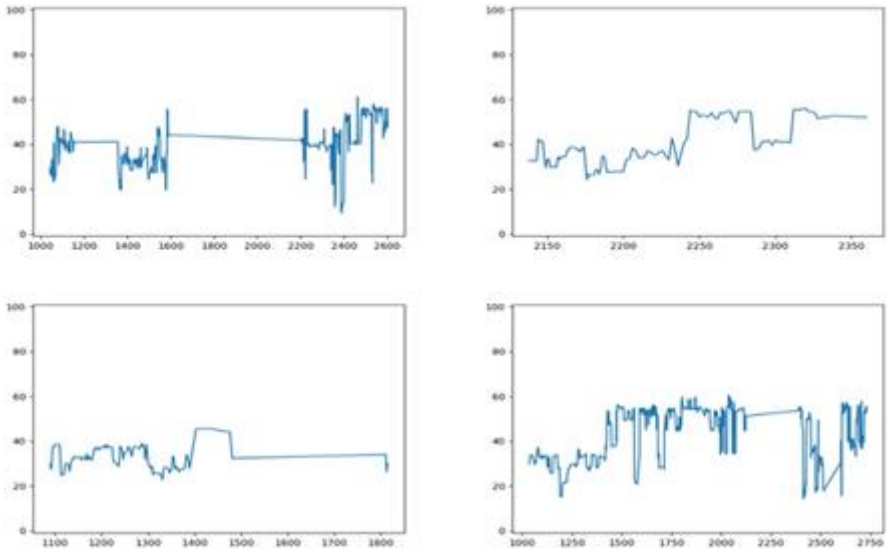


Figure 6: Stress results over time from the 1st pilot

During the 2nd phase of xR4DRAMA, a fusion module was also developed, which is responsible for fusing the stress levels results produced from the sensor and audio analysis respectively. The fusion module was developed to further improve the overall performance of stress detection by utilizing results from multiple modalities. This fusion module was implemented in the 2nd pilot, which results are presented in Figure 7. Again, from the Figure it can be seen that during the 2nd pilot, the stress levels of all subjects were at medium levels since once more there was no real stressor present during the performance of the pilot.

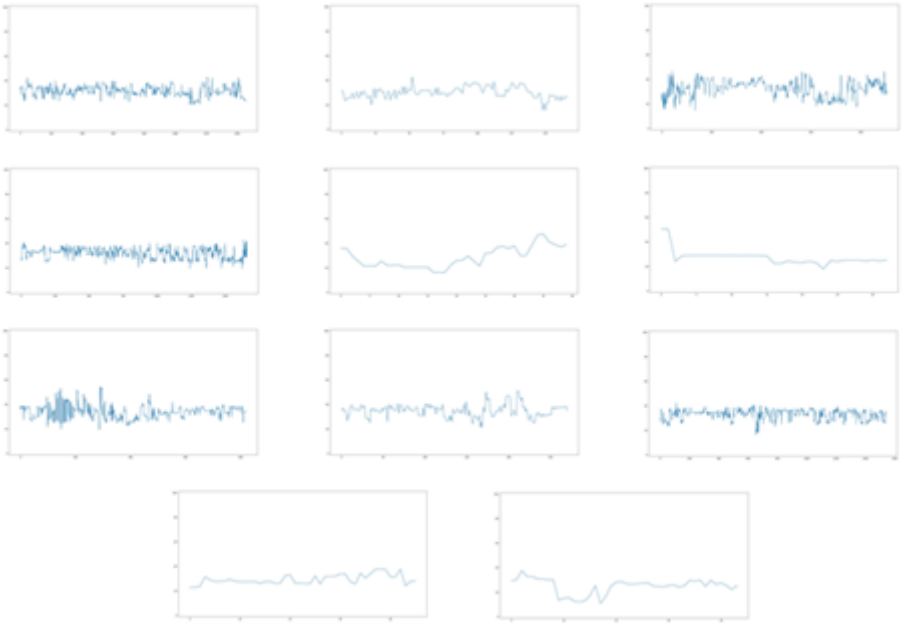


Figure 7: Stress results over time from the 2nd pilot

2.4 **Audio based stress level detection component**

The audio-based stress level detection component produces an estimation of a person's level of stress based on the recorded audio of their voice. It can be applied to First Responders in the field (based on radio communication or other audio recordings) or to incoming phone calls (or voice messages) from citizens to the emergency service's phone lines.

For prototype 1 an initial version of the audio-based stress detection module was integrated in the platform, receiving audio recordings, and passing its output to the stress fusion component to produce a stress level estimation combining audio and sensor base detection. For prototype 2 a second improved detection model was then trained and integrated with the fusion component. It was evaluated independently (with much improved accuracy compared to the initial iteration) as reported in D3.10 and used in the second round of pilots in conjunction with the fusion component.

2.5 **Visual analysis component**

During the 1st xR4DRAMA's period and until the 1st PUC1 pilot, CERTH has developed the initial visual analysis pipeline that consists of the following modules:

- *Shot Detection (SD)* detects transitions of video scenes and spits them in proper video shots to facilitate the next analysis steps.
- *Scene Recognition (SR)* characterises the type of the scene depicted in the analysed image or video shot. In total, 99 scene categories are supported to cover xR4DRAMA's needs.
- *Emergency Classification (EmC)* detects flood in the analysed image or video shot.

- *Photorealistic Style Transfer (PST)* is used as a pre-processing step for the BOL module.
- *Building and Object Localisation (BOL)* localises buildings, objects and other elements in images and videos and enhance system's semantic information. In case of flood, it provides information about the number of people and vehicles that are in danger. This module also functions as a pre-processing step for the 3D reconstruction (only "outdoor" video shots are sent to 3D reconstruction, while people and vehicles are blurred).

The initial versions of the developed modules were integrated into the 1st version of the visual analysis service, which, in turn, was integrated into the xR4DRAMA system (communication with the KB and the 3D reconstruction service). Finally, the visual analysis service has been adapted in order to receive input from Data Collection (WP2), the citizen application and the authoring tool. In case there is geolocation information, corresponding points-of-interest (POIs) are created so that we can associate the extracted information with them.

During the final period of the xR4DRAMA project, CERTH adapted the visual analysis service in order to provide information for the creation/update of POIs. The service was also connected with the xR4DRAMA authoring tool to analyse users' input (images & videos). A new Photorealistic Style Transfer (PST) model was designed using Haar wavelet pooling layers trained on low-lighting images[3] aiming to enhance the performance of Building and Object Localisation (BOL) for challenging images of poor lighting and weather conditions. Moreover, the algorithm for the pre-processing of video frames for the 3D reconstruction was updated, while the overall analysis time of the visual analysis service (Scene Recognition, Emergency Detection, Building and Object Localisation modules) was reduced after some code modifications. In addition, a new module was added for *River Overtopping Detection (ROD)* that receives input from static cameras installed at Ponte Degli Angeli (Vincenza). The deployed algorithm estimates the water level and generates an alert when a threshold is exceeded. The algorithm runs every 15 minutes. The alert values are the following: *0: Minor, 1: Moderate, 2: Severe* and *3: Extreme*. When the alert values are "2: *Severe*" or "3: *Extreme*", detection of people and vehicles in danger takes place too.

2.6 **Audio and textual analysis**

The audio and textual analysis component serves to extract and structure relevant information from audio-based (speech) and written textual content.

For prototype 1, automatic speech recognition was integrated in English and Italian, providing transcripts of audio messages sent through the Citizen App. It was successfully tested during the disaster management pilot in Vicenza. The speech recognition was replaced with a significantly better model in prototype 2, while maintaining the same functionality and platform integration.

[3] Batziou, E., Ioannidis, K., Patras, I., Vrochidis, S., Kompatsiaris, I., "Low-light image enhancement based on U-Net and Haar", 2023, In Proceedings of the 29th International Conference on Multimedia Modeling (MMM 2023), 9 - 12 January 2023, Bergen, Norway, DOI: 10.1007/978-3-031-27818-1_42

The output from the speech recognition module, as well as other written messages is then passed to the text analysis module, which extracts relevant information from the text and provides a structured representation of its content. This feature has been applied during the first round of pilot tests to the messages from the Citizen App as well as to the tweets previously collected by the crawler. The aim of this is to detect and tag emergency-related situations (such as people in danger, blocked or flooded roads, etc.) for the disaster management use case, with limited support for the media production use case. In the second round of pilot's content from FourSquare was added by the crawler, providing more general information about a location, in particular with regard to logistics relevant to media production (such as the availability of electrical outlets, internet access, parking spaces, etc.). The information extraction module was correspondingly extended to cover the need of the media production use cases, while also significantly improving the coverage and quality for the disaster management use case.

2.7 **Decision Support System**

This component is responsible for the inference techniques that are developed for decision support framework in the domains of media production planning and disaster management, and semantic content annotation and integration. The main issues addressed in this component are two: a) Dealing with probabilistic information coming from the various modalities and content retrieved from search. b) Being able to reason efficiently upon a large knowledge base. In the first prototype, for the Decision Support System (DSS) component we have: i) identified the fields and data that will be needed for decision support, ii) defined a list of competency questions regarding the collected data to be used in the ruleset, and iii) formulated the first version of the semantic reasoning ruleset (I.e., risk aggregation, citizens-to-protect, and other). Moreover, for the DSS component we have constructed an information retrieval mechanism, which when given a project id, and two timestamps can retrieve information that can help the textual generation mechanism and the backend end API.

The second prototype of the DSS is based on the creation of Points Of Interest (POIs). More specifically, when a POI is created or updated, some information from the POI are sent to the DSS component, such as the number of affected objects or persons, the type of destruction, and the coordinates. Next, the DSS component computes a severity score, based on the aforementioned information, in order to add the severity score to the POIs, which have been considered related to the message by textual or visual analysis. Along with the severity score assigned to POI the DSS creates a danger zone surrounding the POI. More specifically, given the coordinates of the POI the DSS creates a bounding box with the POI being the centre of the bounding box, if a danger zone does not already exist. In the case a danger zone overlaps with the produced bounding box then the existing will be merged with the new danger zone, or the existing danger zone will remain unchanged.

Another functionality of the DSS is to assign tasks to the POIs for the first responders to see. More specifically, the DSS sends a message that contains a task to all the POIs existing in a specific area, which is inferred from the coordinates of the message, and assigns the task from the message to all the POIs in it. If the POIs do not have already a task, then the task is

automatically attached to POI, but if the POIs have a task assigned to them, then some reasoning between the information in the POI and the information in the message is performed in order to see if there will be attached an extra task or the POI will remain unchanged.

2.8 **Text generation module**

The text generation module converts structured information from the various analysis components (textual, visual, stress, etc.) into human-readable reports or messages. It can be used to prepare aggregated documentation as well as status or situation updates or messages.

For the first prototype, a preliminary version of the text generation module was implemented in the context of disaster management domain. Given a project id and two timestamps, the module receives the information selected by the DSS component and provides a verbal summary in English or Italian of the emergency situations that occurred in that timeframe. The generation is performed using the UPF grammar-based generator FORGe (Mille et al. 2019)[4], which allows for multilingual generation of more or less complex structured data. A detailed description of the implementation can be found in *"D3.6: Multilingual information generation techniques v1".*

For the second prototype, regarding the disaster management use case, the quality of the status/situation summaries was improved, and new functionality was implemented to generate a title and small description for the POIs created from text and visual analysis information.

Regarding the use case of media production, the module generates a report by organising in a coherent and cohesive way the relevant information coming from the data acquisition and language analysis modules. This report contains a general overview of the location as well as information about the target area such as the usual weather, infrastructure availability (e.g., restaurants, hotels, hospitals, parking, internet, …), etc. As for the disaster management use case, POIs with automatically generated titles and descriptions are created based on the information extracted from textual sources such as review sites (e.g., FourSquare).

2.9 **Semantic Integration**

The main functionality of the Semantic Integration component is the generation of the mappings responsible for directly linking heterogeneous digital evidence including audio, video, text, and sensor analysis. In the first prototype, for the semantic integration mechanism it was possible to integrate the messages from the other components (i.e., visual, textual, and stress level analysis), both for PUC1 and PUC2 requirements. In addition, the knowledge graph scheme has been updated to represent all the knowledge needed for PUC1-PUC2. Moreover, the semantic integration mechanism has been enriched with an information retrieval

[4] Mille, S., Dasiopoulou, S. and Wanner, L., 2019. "A portable grammar-based NLG system for verbalization of structured data". In *Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing*, pp. 1054-1056, DOI: 10.1145/3297280.3297571

mechanism, which when given a project id and two timestamps can retrieve information that can help the textual generation mechanism and the backend end API.

The second prototype of the semantic integration mechanism is mainly about creating or updating a POI. More specifically, when a message is received from the textual or the visual analysis component, the integration searches for similar POIs, based on location, category, and sub-category labels, and if one is found it updates the information in the similar POIs. Otherwise, the integration mechanism creates a new POI. The integration mechanism also consolidates the textual generation mechanism to create a tittle and a description for the POI, by giving some information from the POI to the textual generation mechanism.

Additionally, every time a new project is created, the knowledge base receives (from the Web data collection module) and stores the automatically collected Wikipedia general description of the area that the project is located, the emergency numbers, and the legislation for video recording and drone usage in public places.

2.10 **3D reconstruction service**

The 3D Reconstruction Service of xR4DRAMA platform is a web application that produces photorealistic 3D models from images and/or videos, completely automatically. In the current development cycle of the service, the primary purpose is to create 3D models to enhance actors' situation awareness on the ground and to facilitate the two use cases of the xR4DRAMA platform. Figure 8 show the 3D model that has been reconstructed from drone footage via the xR4DRAMA service for the media planning use case.

Figure 8: The 3D reconstructed model of the Venetian fortress in the city of Corfu

2.11 **Satellite service**

In the xR4DRAMA satellite service, the user can download satellite data by specifying a bounding box for the area of interest, a time interval (start and end), and a list of raster types (True-Color or/and Multispectral image and Digital Elevation Model). Moreover, satellite data can be downloaded for multiple timestamps by defining the parameter. All results are stored in the service, so the user makes future search requests. The results are visualised in the Authoring tool and the VR application. Figure 9 shows a reconstructed terrain from WorldView data.

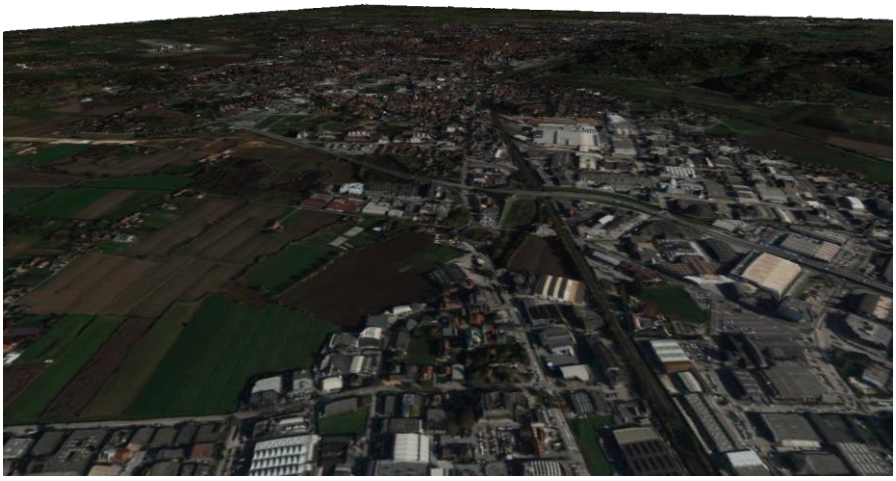


Figure 9: A terrain model of Vincenza from the WorldView multispectral and DEM data

2.12 **End user tools**

2.12.1 **VR and Authoring tool**

The Final prototype of the xR4drama VR and Authoring tool, developed as part of WP4, was developed based on the updated requirements from the users concerning and the product development, from architecture of the tool to the functionalities and the installation requirements. In the following there is a summary of the major updates, described in detail in deliverable D4.6.

1. Updated UI and UX, in particular the menu bar on the left side of the screen to help in navigation of various screens.
2. Integration of Text Generation which uses the data found on the internet to create a text which will be helpful to enhance users' situation awareness.
3. Integration of Satellite Data.
4. Integration of Flood Maps and forecast models from AAWA Servers, including the data coming from various water level sensors.
5. Integration of Population density Map.
6. Integration of the new 3D model reconstruction pipeline.
7. Broadcasting of messages to Citizens (though the Citizen app).

8. Integration of Global search for all the POIs and data stored in a project.
9. Easier way to add files, danger zones, POIs, and Media Content.
10. Integration of Stress levels coming from the physiological sensors for the disaster management use case.
11. Integration of Visual Analysis results for Images and uploaded content.
12. Uploading of 3D models to be used in VR AR App to create AR scenes.

2.12.2 **AR App**

The final version of the xR4DRAMA AR app is connected and integrated with the backend and the GIS Service and has fulfilled the requirements with specific features and processes within the app. The 2D screens of the user interface and the 2D map view of the app were developed with fully operating features, such as receiving points of interest (POIs) from the GIS, editing, updating, uploading multimedia at POIs, and getting navigation routes that consider danger zones. Furthermore, the features related to POIs work in the AR view for enhanced visualization and interaction. The accuracy of the outdoor navigation and the pose estimation of the user have been improved in this final version using a combined method of visual SLAM through AR implementation and GPS localization. The final version also includes an extensive and thorough experimentation on object detection using ML, the outcome of which is fully integrated into the app as an advanced feature for scene understanding purposes.

All the new features and functionalities implemented are described in detail in deliverable D4.7. Figure 10 presents some screenshots of the Augmented Reality application and Figure 11 shows screenshots of the AR application while placing digital models from the users on top of real world.

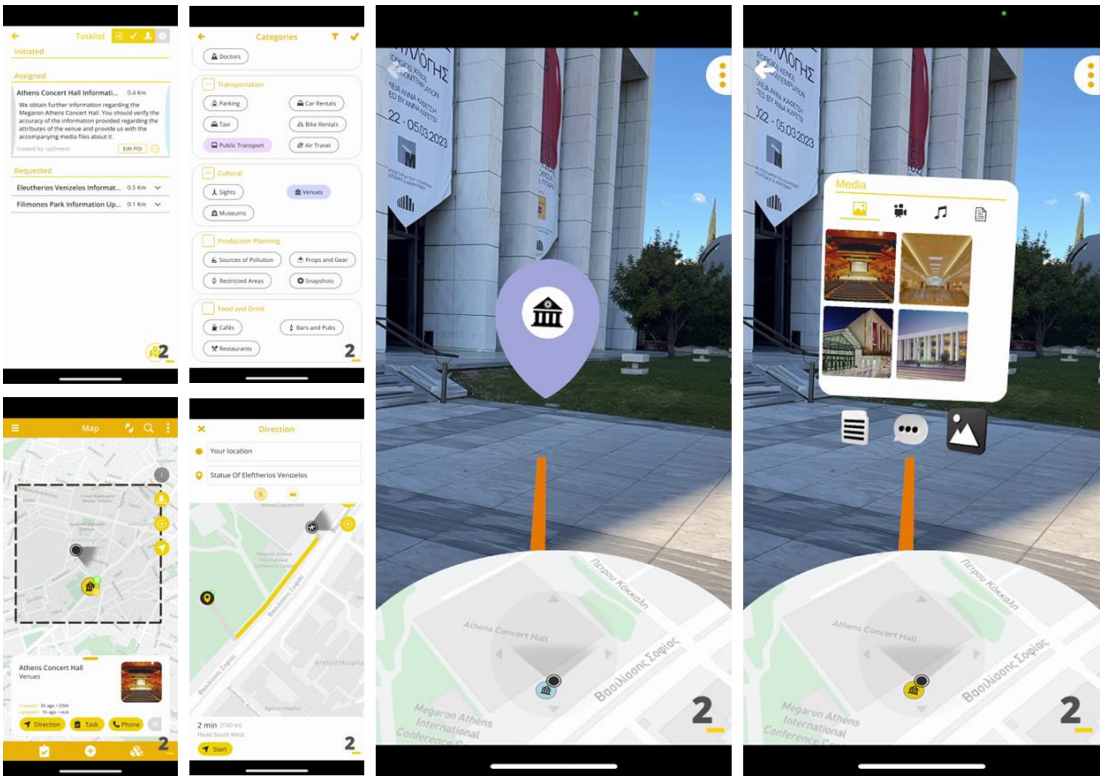


Figure 10: Indicative screenshots of the Augmented Reality field-task management application

Figure 11: Indicative screenshots of the Augmented Reality field-task management application

2.12.3 **Citizen Mobile App**

During the 1st PUC1 Vicenza pilot, the prototype version of the Citizen Awareness app (V1.0) was released and tested. The prototype version included the following functionalities:

- Citizen text report creation and submission to the xR4DRAMA platform.
- Citizen audio report creation and submission to the xR4DRAMA platform.

- Citizen image report creation and submission to the xR4DRAMA platform.
- Automatic attachment of geo location of the user to the submitted reports.
- Situation aware notification system (text alerts) to inform the user regarding the event status.
- Inclusion of a first responder mode that connects and organizes the physiological signals to the xR4DRAMA database.
- Authentication for first responders.
- Multilingual support (English and Italian).

Regarding the 2nd PUC1 Vicenza pilot, the final version of the Citizen Awareness app (V2.0.8) was released and tested. The final version included all the functionalities reported in the prototype version and then the following new functionalities were added:

- Citizen video report creation and submission to the xR4DRAMA platform.
- Improved situation aware notification system (text alerts) including a notification centre for text notification archiving and alert for presence of unread notification by the user.
- Addition of map showing exact user location.
- Improved situation awareness by showing the registered danger zones from the rest of the front-end tools (Authoring tool and AR app) on the map of the application.
- Improved situation awareness by showing all registered disaster management POI subcategories (Flood Reports, Risk Areas, Civil Protection, Civil Protection Distribution Places, and Safety Areas) on the map of the application.

The Citizen Awareness app consists of two separate modes one for citizens and one for first responders. Figure 12 presents how all the citizen awareness app functionalities related to the citizen mode interact with the main actors (citizens and first responders) and the rest of the xR4DRAMA tools. Figure 13 illustrates the first responder mode functionalities combined with the rest of the xR4DRAMA tools specifically how the app connects with the smart vest and streams the physiological data so that they can be analysed and produce the stress levels of the first responders. More detailed information about the Citizen Awareness app can be found on Section 8 of D5.4 – “Prototypes and mobile development v2“.

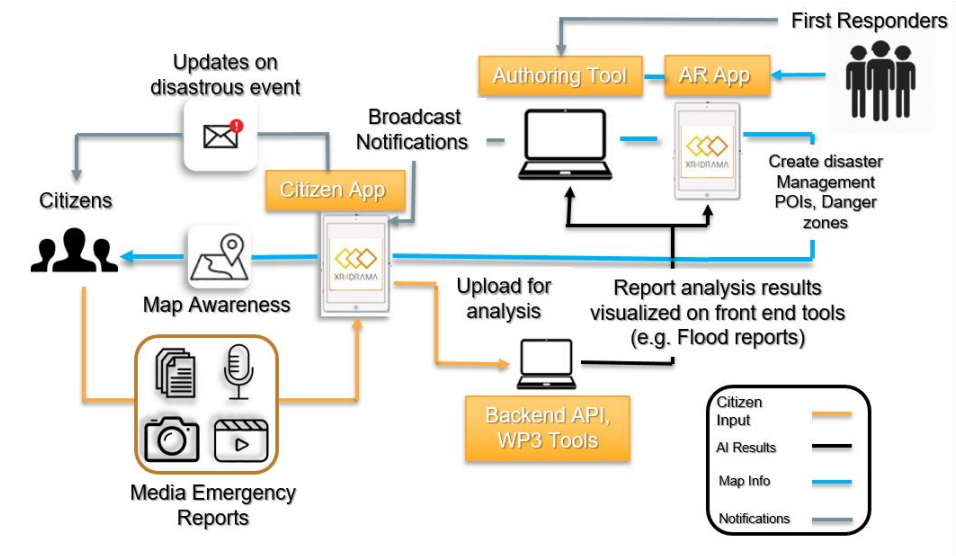


Figure 12: Citizen mode pipelines for PUC 1

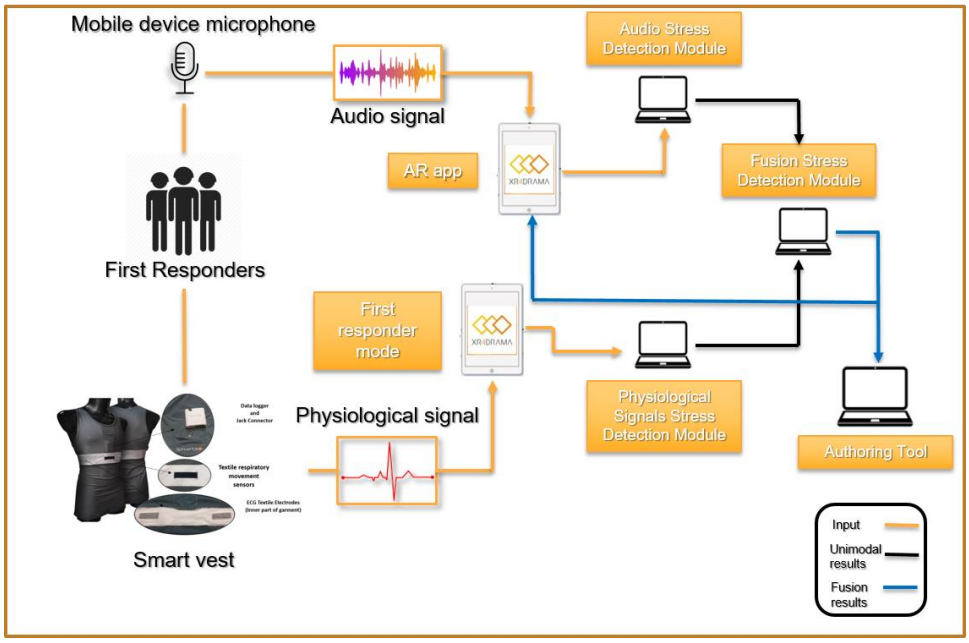


Figure 13: First responder mode pipelines for PUC1

3 GENERAL APPROACHES

This chapter discusses the general approaches followed for the setting up and the evaluation phase of the project an end-user perspective. These approaches were shared and discussed with all the Consortium partners.

3.1 **Disaster Management**

3.1.1 **Approach for the pilot**

The pilot to test and evaluate the final xR4DRAMA system was organized based on the following steps, with the active involvement of the end users in each of them:

- General test of the xR4DRAMA pilot (28th of February -6th of March 2023): this activity was intended as pre-test of the technologies of the final system.
- Training of the end users to the xR4DRAMA technologies (28th of February in AAWA headquarters and 2nd of March 2023 in Vicenza municipality):
- Pilot execution on the 7th and 8th of March 2023: performed by the end-users and stakeholders of the flood scenario in Vicenza.
- Debriefing of the pilot for its evaluation (8th of March 2023 in the afternoon).

During the phases of the pilot, the following roles had been assigned:

- Control room operators: they used the Authoring tool to receive forecasts, real time monitoring of the outcome of the crisis, to send global alerts to the citizen and to establish a bidirectional communication to/from the first responders (equipped with the AR app and Smart vests). During the pilot, the participants who played these roles remained in the control room. This role was performed by members from the Municipality of Vicenza and AAWA.
- Civil protection volunteer teams: the leader of each of these teams used the xR4DRAMA AR app to communicate with the control room, providing incident reports (text and/or video, photos) and receiving tasks from the control room to perform; during the pilot there were five teams of first responders. This role was performed by Vicenza Civil Protection volunteers.
- Citizens: they used the xR4DRAMA Citizen app to send incident reports (text and/or video, photos) and to receive notifications from the control room. During the pilot, the participants who played the role of 'Citizen' were located in specific areas of the city, according to the storyline. This role was performed by AAWA technicians.

3.1.2 **Approach for the evaluation**

The evaluation of the final system was based on:

- Observation sheets: these sheets collected the notes taken by the actors in each of the three sessions. Each actor was assigned a specific type of role with the aim of taking note of each performed task and occurred problems.
- Feedbacks collected in the debriefing: the debriefing session took place immediately after the pilot, where the participants share opinions and provided useful feedback on their experience with the xR4DRAMA technology, regarding their roles, on what they liked, on difficulties experimented and suggestions of improvement. All contributions from end-users were translated by AAWA staff in the presence of the xR4DRAMA Consortium.

The observation sheets were aimed at guiding end-users in the timely verification of the adherence of the xR4DRAMA platform integrating all its modules with the user requirements (evaluating in quantitative terms their percentage of completion), focusing on the PUC1-specific ones.

A qualitative assessment of the xR4DRAMA has been done by the end-users with the help of interviews, hot debriefs and written feedbacks to collect the results in terms of user satisfaction about the usefulness of the platform in real-life experiments. The users were asked to express their opinion about the usability of the system in real situations, its flexibility and efficiency of use, its ability to provide help and documentation, the clearness in visualizing the provided information from the system, its general capacity to enhance the situation awareness. The end-users group involved a relatively small number, 16 people (6 AAWA technicians in the role of citizens; 5 Civil protection volunteers of Vicenza; 5 control room operators from AAWA and Vicenza municipality), not including some local reporters who followed the activities. The group was highly qualified in disaster management and in risk management-related technologies, and with a representation of different ages and genders.

3.2 **Media Production Planning**

3.2.1 **Approach for the pilot**

The test of the final xR4DRAMA prototype took place in Berlin and Corfu and followed the general approach of the different steps defined at the beginning of the project.

Step 1

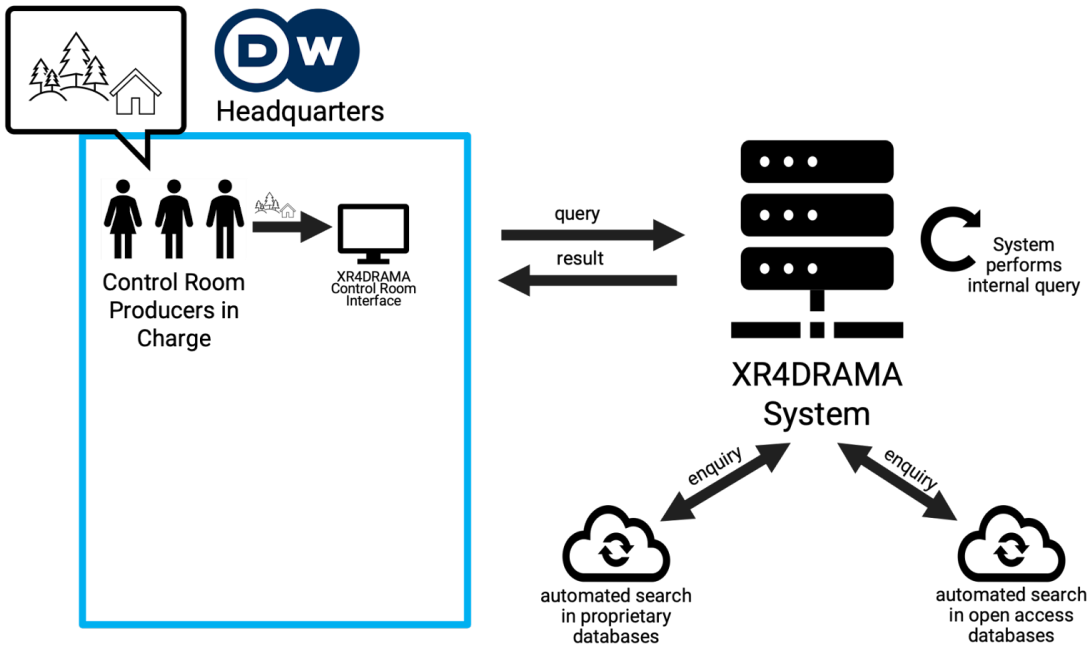


Figure 14: Graph of step 1 in PUC 2

In the first step, only personnel at DW's headquarters were involved. It took place on February 20 and 21, 2023 and was carried out by DW's xR4DRAMA team.

Step 2

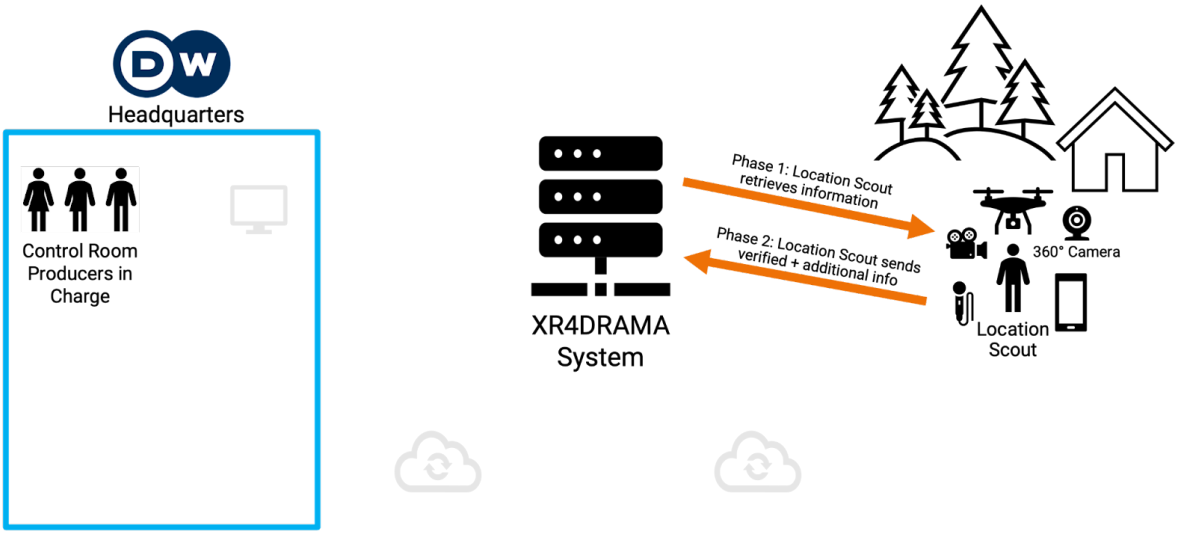


Figure 15: Graph of step 2 in PUC 2

In line with the use case scenario, this step took place on the Greek island of Corfu. Alexander Plaum, one of the members of DW's xR4DRAMA-team, took the role of the location scout and gathered data and information according to the tasks he received via the AR app. This included taking 360° photos, smartphone photogrammetry, audio recordings etc at various sites in the old town of Corfu on March 13 and 14.

Step 3

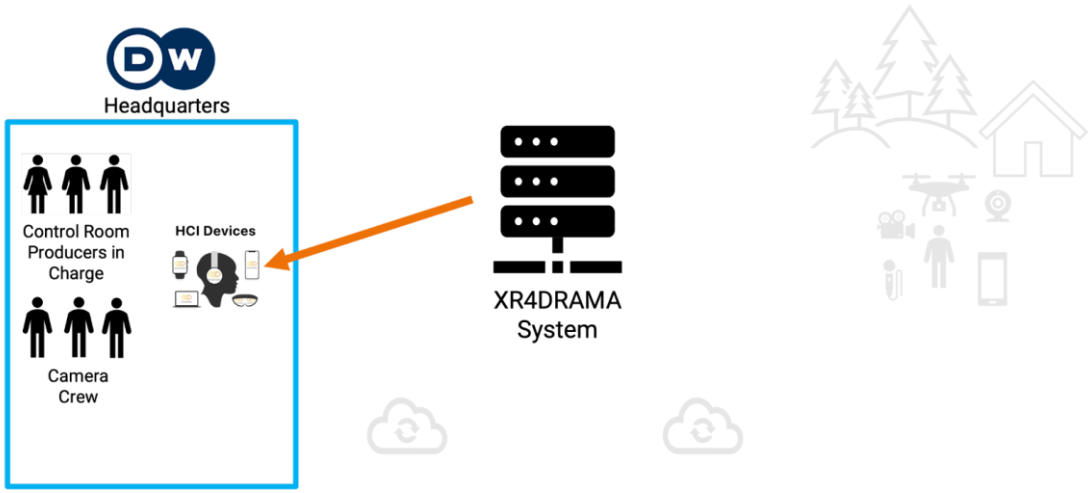


Figure 16: Graph of step 3 in PUC 2

In this final step of PUC 2, Axel Primavesi, also a member of DW's xR4DRAMA-team, took the role of the producer at the DW headquarters in Berlin. He checked all the information gathered in step one and two not only via the authoring tool in the desktop mode, but also in VR mode (to check the third level of Situation Awareness).

During that last session of the xR4DRAMA final prototype testing in PUC 2 representatives of all technical partners were present.

3.2.2 **Approach for the evaluation**

The first prototype was evaluated with a combination of a checklist approach and a qualitative approach (compare D6.3). The reason therefor is simple: a large-scale quantitative testing would not have made sense here due to the complexity of the use case and the need to understand

a) media productions/journalism
b) immersive technology
c) the xR4DRAMA software application kit (desktop and mobile).

For the evaluation of the final prototype DW again chose a combined approach. Besides the checklist ('What has been implemented? And how does it work?' – s. detailed list in section 5.5) the evaluation happened in a quantitative manner. A group of dedicated users at DW (media people who were not part of the xR4DRAMA team) who got to know the system very well during the late period of the project took part in a survey (s. section 5.6).

By this combined approach for the evaluation, it is not only possible to map the status of the final prototype with the requirements developed in the early stage of the project. There is also feedback from several potential users in all the fields that xR4DRAMA aims at.

4 DISASTER MANAGEMENT PILOT IN VICENZA

4.1 **Description of the Site**

As performed for the first Disaster Management pilot described in D6.3, the second pilot took place in the areas of the city of Vicenza city most affected by the past floods, setting the Municipal operative command centre (or Control Room - COC) where it is established in case of a crisis that involves the Municipality. In this room, for the entire duration of the pilot, the Decision maker was settled, together with the COC delegates, the control room operators, and the observers.

End-users with the role of first responders and citizens were divided in teams deployed on Vicenza City centre, in the most critical points (in terms of flood risk) along the Bacchiglione River, to test the mobile apps. Some of the chosen points are the location where the Municipal

Civil Protection plan defines some preventive actions that must be taken by Civil Protection Volunteers when the water level in the Bacchiglione River exceeds the alert thresholds.

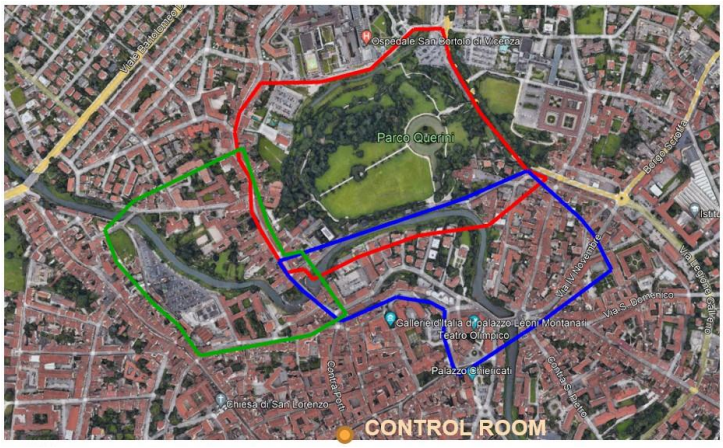


Figure 17: City areas involved in the pilot

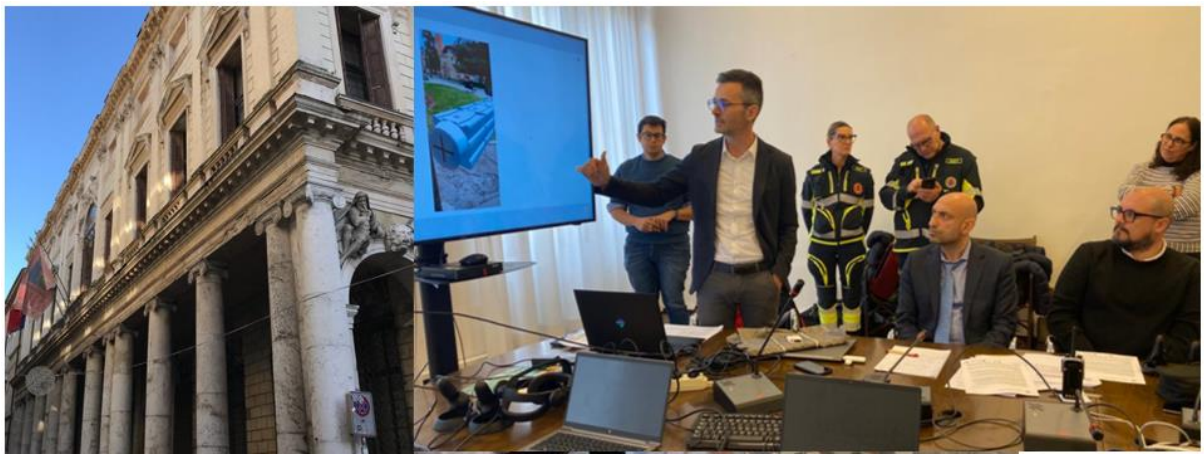


Figure 18: Control room at “Sala Chiesa” - Palazzo Trissino, Corso Andrea Palladio 98, Vicenza

4.2 **Agenda of Activities**

In the following table is provided the official agenda of the disaster management second pilot and of the related activities.

Tuesday, March 7th				
Start	End	Subject	Presenter	Duration
9:30	9:40	Welcome – Introductions	AAWA	0:10
9:40	10:10	xR4DRAMA Presentation - project progress	CERTH	0:30
10:10	10:40	Introduction to the second Pilot objectives and scenario	AAWA	0:30
11:00	12:15	Components presentation (15 minutes each)	NURO UPF CERTH U2M Smartex	1:15
12:15	12:45	Explanations of the roles and agenda of the 2 days pilot	AAWA	0:30
14:00	15:30	Training of the participants – AAWA and Vicenza COC personnel (including the testing of the functionalities)	ALL	0:50
15:30	17:00	Trial Session - Phase 1 (UC_1) - pre emergency	ALL	1:30
18:00	19:00	Training of the participants –Civil Protection volunteers	AAWA, Smartex, CERTH, U2M	1:00
19:00	19:15	Wrap up of the day and presentation of following day	AAWA	0:15

Table 2: PUC1 Pilot's Agenda – Day 1

Wednesday, March 8th				
Start	End	Subject	Presenter	Duration
9:30	9:40	Pilot Briefing	AAWA	0:10
9:40	11:10	Trial Session - Phase 2 (UC_2) - during crisis, information update by first responders	ALL	1:30
11:30	13:00	Trial Session - Phase 2 (UC_2) - during crisis, information update by first responders: Presentation of the system to the Mayor of Vicenza	ALL	1:30
14:00	14:30	Briefing with the volunteers on Phase 2 activity	ALL	0:30
14:30	16:30	Trial Session - Phase 3 (UC_3) - during crisis, emergency management	ALL	2:00
17:00	17:30	Debriefing, Conclusions	ALL	0:30

Table 3: PUC1 Pilot's Agenda – Day 2

4.3 **User story**

The story line for the disaster management pilot is divided into three sessions to cover all the flood Use Cases:

- Phase 1 - pre-emergency
- Phase 2 – during crisis: information update by first responders
- Phase 3 – during crisis: emergency management

In phase 1 the operators in the control room need to display all the information related to the forecasted flood and the flood risk in the area to manage the situation according to the Municipal Civil Protection Plan (expected flooding scenario, information about the potential presence of people, cultural or natural sites in areas at risk, sensor measures (e.g., water level) available (observed and forecasted), satellite images, etc.).

In phase 2 the operators in the control room need to verify whether the actual conditions coincide with the forecasted ones. In this phase the data collected from the territory is essential, both thanks to the help of first responders in the field and of citizens who can report flooding emergencies and critical situations in the territory. Citizens send incident reports to signal to the authorities that flooding occurs in various areas of the city center.

The system receives the reports that are geolocated and categorized in points of interest (POIs) in the category “Disaster management” (Flood reports, Humans in danger, Animals in danger, Infrastructures in danger, objects in danger, etc.) These POIs on the map can be assigned as a task to the volunteer to be verified and edited with additional information. It is possible to perform a task guided by the app to reach the site and edit the POI on the map by sending multimedia files (audio, video, images), which are displayed in the control room.

In phase 3, during the emergency, it is important for the control room to monitor the status of first responders, to better assign tasks. The Civil Protection has a set of pre-defined tasks to assign to the first responders' teams: the exceeding of different thresholds at “degli Angeli” bridge triggered a set of pre-defined tasks in the Civil Protection plan in critical points in the city. The control room needs to assign tasks, check the stress level experienced by the first responders in the field and monitor the tasks execution in real time, guiding the first responder to optimize his/her performance and ensuring safe conditions.

A first responders’ team can be sent to verify which intervention could solve the potential critical issue where the model signals possible expected flooding or there is the presence of critical issues reported by citizens. The operator can go on site guided by the app, visualize the flooding predicted by the forecast model, add three-dimensional elements in augmented reality mode, verify how many elements/modules are needed to build a suitable flood barrier and measure its development, and finally communicate this information to the control room (with reports and images).

4.4 **Training activities**

The aim of this activity was to provide to the users involved in the pilot a general overview of the xR4DRAMA project and to train them on the main features of the xR4DRAMA apps required for the pilot, explaining their role in the pilot itself.

During the training sessions AAWA team provided the end-users with manuals to explain the features of the xR4DRAMA mobile apps and Smart vests and devices, helped them to install the applications and connect the devices.

Figure 19: Examples from the User Manuals

Figure 20: Training at the AAWA headquarters and in Vicenza

Figure 21: Experiencing the use of the Smart vest

4.5 **Pilot Process and Outcomes**

4.5.1 **SESSION 1: UC_1 Pre-emergency management**

1st level of situation awareness: **all the information related to the forecasted flood and the flood risk in the area** to manage the situation according to the Municipal Civil Protection Plan.

In the Municipal operative command centre, the operators were able, using the **Authoring tool**, to create a project, designates the collaborators, view the various generic GIS layers (e.g., public services, transportation, cultural site, natural elements, infrastructures) and use case specific ones (e.g., flood risk maps, safety areas, flood forecast).

The operators were also able to display the information about the presence of people, cultural or natural sites in areas potentially at risk, although with some limitations (that will be described in detail in the feedback report).

The control room operators were able to view the various sensor measures available (observed and forecasted water levels along the Bacchiglione river), information derived by satellite image services and automatically created task list based on the Civil Protection Plan actions and the relative activation threshold (result of the Decision Support System).

Figure 22: Operations in the Control Room (phase 1)

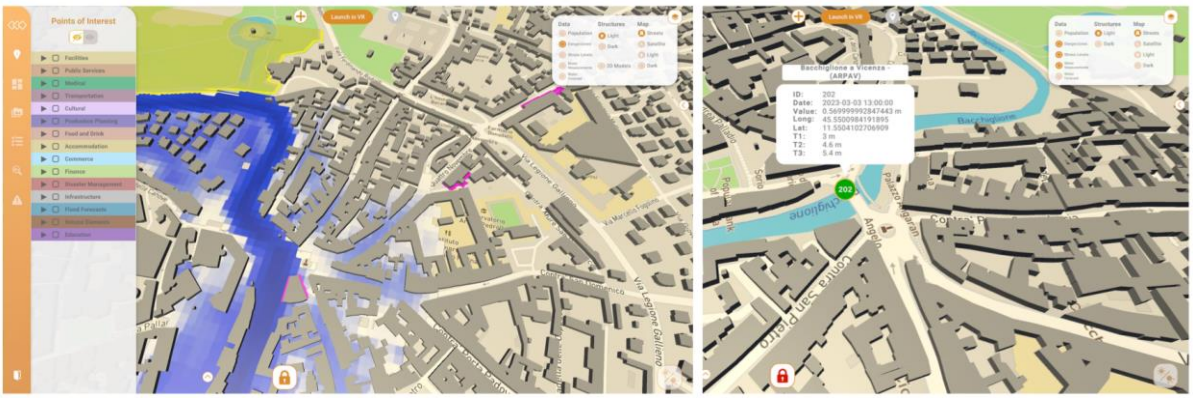


Figure 23: Information in the Authoring Tool: flood forecast scenarios and sensor measures (phase 1)

4.5.2 **SESSION 2: UC_2 Information update by First Responders**

Data collecting from the territory, both thanks to the help of first responders in the field and thanks to citizens who can report flooding emergencies and critical situations in the territory.

In the Municipal operative command centre, the operators were able to display in the **Authoring tool** (AT) the information arriving from citizens (sent originally via the **Citizen App**) as result of the visual or textual analysis, categorized in the POIs "Disaster management" category: Flood reports, Humans in danger, Animals in danger, Infrastructures in danger, Objects in danger, based on the degree emergency (type of elements at risk).

The control room operators created specific tasks, connected to the citizen-generated POIs, to be assigned to the first responders in the field to verify the incoming information. The Authoring tool allowed them to assign the tasks and check their status visualizing all the different categories (requested, assigned, initiated completed) and the information arriving from the first responders in the field (edited POIs complete with multimedia files), sent via the **AR app**.

Based on the incoming information the operators were able to create warnings (broadcasting messages to the citizens) or danger zones in the map, using specific functionalities of the **Authoring tool**.

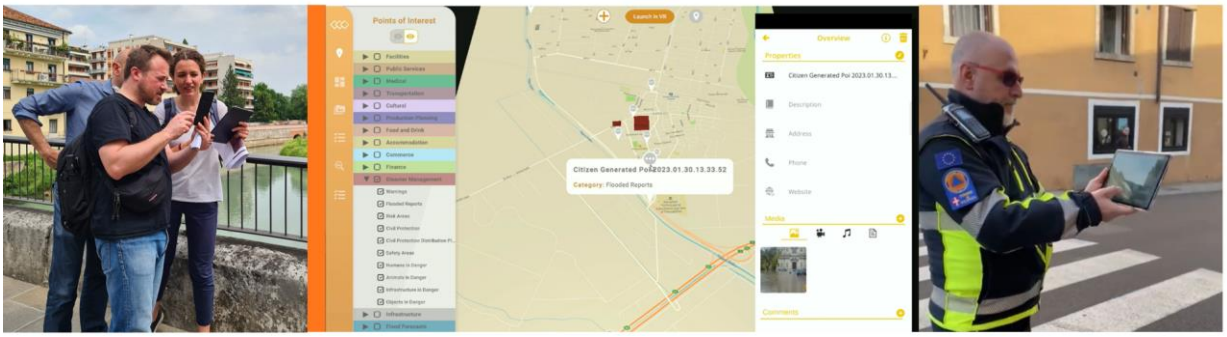


Figure 24: Citizens sending reports; Citizen autogenerated POIs in the AT; First responders verifying the information (Phase 2)

4.5.3 **SESSION 3: UC_3 Emergency management**

Pre-defined tasks of the Civil Protection plan triggered by the exceeding of different water level thresholds at "degli Angeli" bridge to be assigned to the first responders' teams.

In the Municipal operative command centre, the operators were able to assign tasks to first responders in the field and monitor in the **Authoring tool** (AT) their execution in real time, optimizing the performance of first responders' actions and ensuring safety conditions (stress level detection).

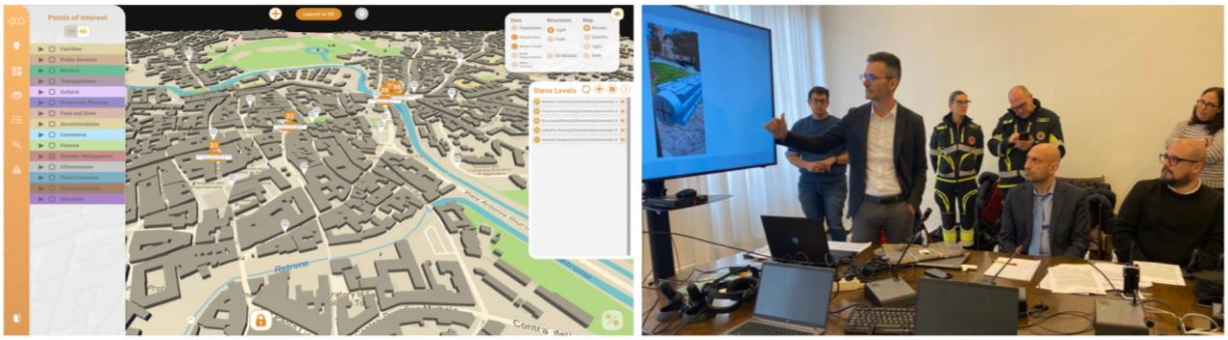


Figure 25: Operators in the Control room monitoring the first responders' stress level and tasks (Phase 3)

First responders, thanks to the AR app, were able to reach the intervention areas using the navigation functionality that allows to avoid dangerous areas. They were also able to monitor their stress level and any warnings in this regard reported by the control room. Experimenting the AR functionalities of the app they checked the forecasted flood level in the area of intervention, and they could simulate the positioning of the Aquadike barrier (important to verify the number of modules and the extension of the barrier necessary to contain a critical situation and to send this information to the control room).

Figure 26: First responders operating in the field wearing Smart vests (Phase 3)

4.6 **Final system status**

4.6.1 **Results of the observation sheets**

Observation sheets were structured as a document to be compiled directly in the field during the trial by the end-users. They were developed for each phase of the emergency to verify the entire workflow of xR4DRAMA platform in simulating a real emergency. The forms of those documents report a series of specific actions that should be performed by the end-user in each phase of the pilot, chronologically ordered to let the user follow totally the storyline and differentiated by front-end tool.

In the following table the results of the of the observation sheets are summarized in terms of the status of the specific actions performed by the end-users during the pilot.

The table compares the performance of the front-end tools obtained in the evaluations respectively during the first (May 17-18, 2022) and the last project pilot (March 7-8, 2023), in terms of actions completed with success from the end-users engaged in the tests. If an action has been successfully performed it is indicated with Y (Yes), an action only partially performed with P, an action not performed due to features not implemented in the platform or not working with N (No).

Front-End Tool	Action to be performed	1st pilot	Final pilot
Authoring tool	login	Y	Y
	create a project selecting an area and entering all information	Y	Y
	add collaborators	Y	Y
	view all GIS layers (e.g., public services, transportation, cultural sites, natural elements, disaster management, infrastructures, etc.)	P	Y
	view the use case specific layers (flood risk maps, flood forecasts)	N	Y
	display the information about the potential presence of people, cultural or natural sites in forecasted flooded areas (elements at risk)	N	P
	view the various sensor measures available (observed and forecasted water levels)	N	Y
	view the information derived by satellite image services	N	Y
	create a task	Y	Y
	launch VR of the area	Y	Y
	explore the VR environment	P	Y
	view the reconstructed 3D model (also in fly-mode)	P	Y

	view the automatically created task list based on the Civil Protection Plan actions triggered by a water level threshold (result of the Decision Support System)	N	P
	display information by citizens as result of the visual analysis	P	P
	display information by citizens as result of the textual analysis	P	Y
	create danger areas based on the incoming information	N	Y
	display information sent by first responders	P	Y
	check the stress level of the operators in the field, sending automatic warnings to the first responders in case of overlaying of specific thresholds	N	Y
	create and assign task based on the incoming information	P	Y
	assign the tasks automatically created (based on the Civil Protection Plan procedures)	N	N
	check the status of tasks	P	Y
	broadcast messages to the citizens using the Citizen app	N	Y
	check the situation in real time	P	Y
VR tool	check the situation in real time in VR mode	P	Y
	view the 3D reconstruction of the area in two ways: at ground level and from an aerial perspective	P	Y
	explore the area in VR mode - drone flight	P	P
AR app	login as first responder	Y	Y
	select categories of interest to visualize	Y	Y
	insert a POI attaching an image	Y	Y
	insert a POI attaching a video	Y	Y
	insert a POI attaching an audio file	Y	Y
	insert an Area of interest	Y	Y
	editing a POI	Y	Y
	accept, perform and complete a task	Y	Y
	monitors his/her stress level and any warnings in this regard automatically generated by the system	P	Y
	verify a report (editing an existing POI)	Y	Y
	use the navigation tool (that allows to avoid dangerous zones)	P	Y
	activate the share location function	N	Y

	launch the app in AR to be guided to the POIs and see the relative information	N	Y
	launch the app in AR to check the forecasted flood levels	N	Y
	launch the app in AR mode to simulate the positioning of an Aquadike (flood) barrier	N	Y
	acquire a video for 3D reconstruction	Y	Y
Citizen app	open the app	Y	Y
	report a critical situation sending texts	Y	Y
	report a critical situation sending audio records	Y	Y
	report a critical situation sending photos	Y	Y
	display his/her position on the map to be sure of being correctly geolocated before sending any reports	N	Y
	display on the map important POIs related to disaster management categories and the presence of dangerous areas	N	Y
	receive notifications	Y	Y
	check the presence of unread notifications	N	Y
	check a summary of his/her sent reports	N	Y
	first responder mode login	Y	Y
	activate and connect the RUSA device	P	Y

Table 4: Evaluation results in terms of actions performed in the final pilot compared to the 1st one

The table compares the performance of the front-end tools obtained in the evaluations respectively during the first (May 17-18, 2022) and the last project pilot (March 7-8, 2023), in terms of actions completed with success from the end-users engaged in the tests. If an action has been successfully performed it is indicated with Y (Yes), an action only partially performed with P, an action not performed due to features not implemented in the platform or not working with N (No).

From the comparison between the results obtained in the 2 project pilots, the progress obtained in the xR4DRAMA technology is evident, thanks to the work of the technological partners who in the last months, following the indications provided by the end-users and collected in D6.3 at the end of the first cycle of evaluation, have brought to maturity a system which now satisfies almost all of the PUC1-specific requirements that had been provided for disaster management, as shown in the following figures. This result was obtained thanks to a constant discussion and collaboration process among the consortium partners and to continuous testing activities.

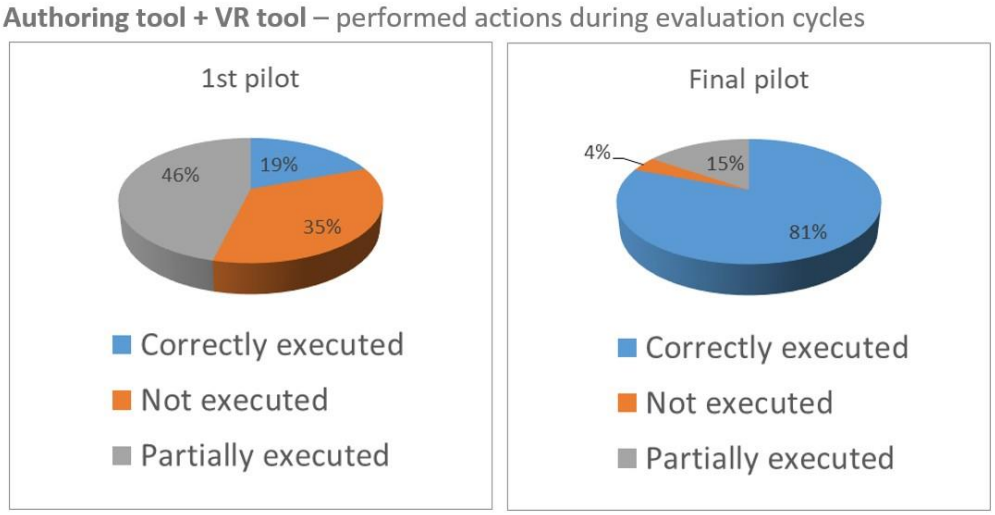


Figure 27: Final status of the AT and VR tool compared to the 1st prototype (in terms of meeting the PUC1-specific requirements)

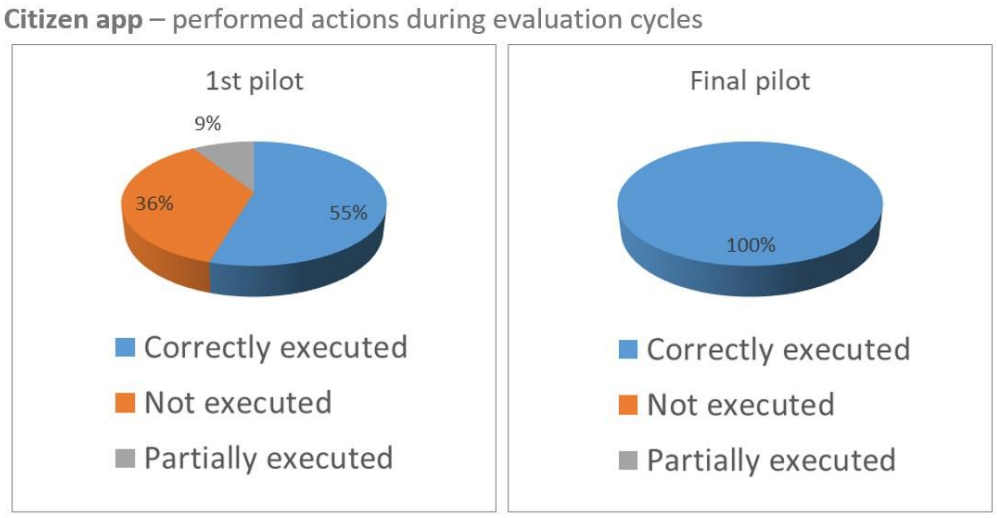


Figure 28: Final status of the Citizen app compared to the 1st prototype (in terms of meeting the PUC1-specific requirements)

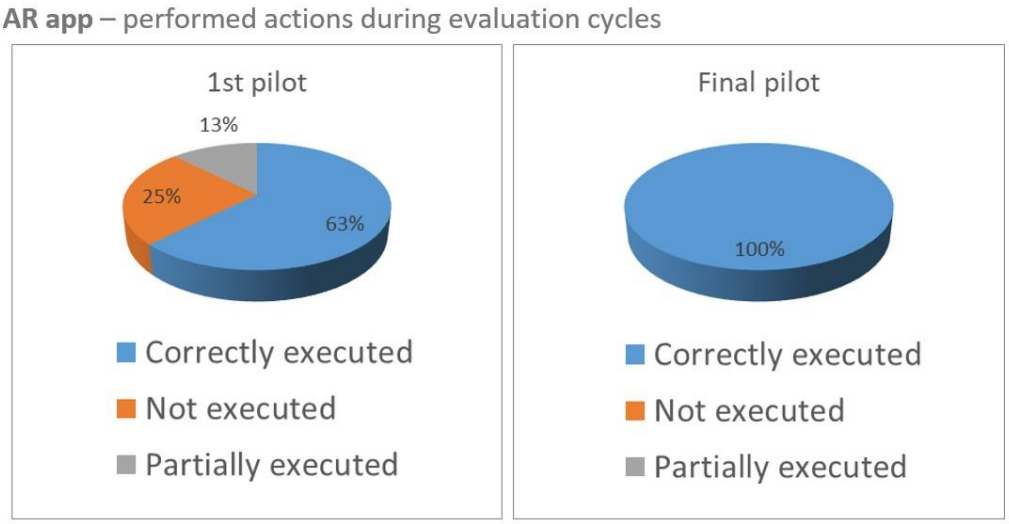


Figure 29: Final status of the AR app compared to the 1st prototype (in terms of meeting the PUC1-specific requirements)

4.6.2 **Summary of the debriefing activities and feedback**

The feedback collected in the debriefing is reported here, divided according to the front-end tool they refer to.

Authoring Tool/ VR tool

1. It is possible to view use case specific layers (e.g., flood risk maps, flood forecasts), but in order to do so, the operator must know their exact name: there should instead be a drop-down menu which, by selecting the type of layer (risk, velocity, water depth), allows the operator to view automatically the layer referred to most recent run (together with the date).
2. The operator can display information about the potential presence of people, cultural or natural sites in areas at risk but these elements are displayed in their entirety within the project area: it would be more useful if it were a sub-selection of elements resulting from their intersection with the actual expected flooded area, so that only the elements subject to the potential risk of flooding are visible. Furthermore, for the population layer, the lack of a legend makes the information unusable.
3. Currently there is the possibility of viewing satellite images but their resolution with respect to the use case area of interest is insufficient to add information and increase situation awareness (the xR4DRAMA system use the satellite data available in Copernicus hub, openly available by EU).

4. In the automatic task list creation based on the Civil Protection Plan multiple tasks of the same type were created and it was not possible to assign them to operators in the field.
5. The completion reports by the first responders were not visible.
6. In the VR the POIs are sometime hidden by the model and not selectable.
7. In the VR (drone flight) for an inexperienced user it is not easy to grasp the remote control and sometimes the controls are not operable.

In general, end users have noticed the progress in the development of the tool compared to the first pilot, appreciating the possibility of following the operators in the field, constantly keeping their stress level under control. The level of resolution of the 3D images has not yet been considered satisfactory for the intended use, but this would require at least some thousands of images taken by a mobile mapping platform from road level (obtainable only with a multi-million-euro cost process as in VR games or Google Earth).

Citizen App

1. End users have reported that the audio files were listed randomly, not in chronological order, and it was difficult to retrieve the last recorded file for sending (even because the files could be hidden by the bar at the bottom of the screen and therefore not selectable).
2. End-users reported that some video failed to send, and the user was not informed if a size limit was exceeded.
3. End-users could not check a summary of their sent reports: the function is not available in the app, but end users have reported it as important for understanding which reports have been sent.
4. For the acquisition of physiological data, the end users reported the need to restore the connection between the RUSA device and the phone several times during the trial.

In general end-users reported that it would be easier to create aggregate report messages (one report with different types of media files to include).

Smart vest and RUSA device

1. The end users reported the need to restore the connection between RUSA and the phone several times during the trial, to send the physiological data. Moreover, some report the persistence of the same level of stress (with small variations) even with the RUSA device disconnected from the vest.
2. The end users judged the smart vest comfortable enough and breathable (better than the 1st prototype). The sensors maintained their position during the pilot's activities.

In general, the first responders declared themselves ready to use the smart vest as an integral part of their equipment, recognizing its usefulness.

AR App

1. First responder can activate the share location function and see the position of the colleagues in the map, but end-users suggested that distinguishing the operators in the field with different colors would facilitate the identification of the closest operator to ask for assistance in an intervention.
1. End users pointed out that to be notified when a task is assigned to you is a very important functionality, currently not present in the app.
2. In AR function that allows to check the forecasted flood levels, end users reported that in the visualization sometimes the water is blue, sometimes inky dark.
3. A first responder can launch the app in AR to be guided to the POIs and see the related information, but the end users highlighted that the distance indicated in the app to reach the POI is that as the crow flies which can be very different from that indicated in navigation mode. It is not a parameter that helps the operator understand which POI (or task) is closer to reach.

In general, the app was judged very intuitive and easy to use with a minimum of basic training. Connection problems were highlighted (they often had to re-enter by re-entering their credentials). This is also linked to the problems of the cellular network (fragility of the networks in an emergency). The functions of the app are also linked to the versions of the devices available. First responders found using the app on the tablet more helpful, allowing for a better view of the AR elements.

Overall xR4DRAMA System

Effectiveness in providing information

The platform has been rated effective in delivering timely information about the current situation, with clearness in visualizing elaborated data from different sources. The platform was able to provide help and documentation to assist the operators in taking decisions and offer flexible and efficient tools to cope with the current situation (e.g., the task-list functionality).

Only regarding some specific functions of the PUC1, such as the display of risk-related layers, the end-users have evaluated that they could be integrated in a more performing way in the platform, limiting the operator's manual intervention to a minimum and improving the clearness of visualization (e.g., adding legends).

General capacity to enhance the situation awareness

The end users present in the control room appreciated the support provided by the platform in obtaining increased situation awareness, especially highlighting the importance of having synthesized and categorized the reports and warnings sent by citizens, of systematising (engineered in database) the information sent by the first responders and an updated picture of their activities in the field, but above all to have real-time information about their status (stress level) in order to be able to implement optimal personnel management in safe conditions. They also highlighted the importance of timely transmission of information

(between citizens and authorities, between first responders and citizens, and vice versa), supported by the platform.

General level of user satisfaction

The end users involved in the pilot all agreed in in considering the usability of the platform to be good, quite simple, and intuitive even without having received training or with basic training, especially as regards mobile applications. Only with regard to the Authoring Tool, a minimum level of training was considered necessary, justified by the role/user who uses it and by the complex and specific functions present.

The platform was judged by the end-users to be an innovative tool above all for having integrated various components and modules together which allow information from different sources and applications to be had in a single system, giving it a unified vision and integrating new technologies such as AR and VR. End –users from Vicenza municipality have expressed a desire for the system to be operational in their disaster management procedures.

Figure 30: The pilot's end-users together with the xR4DRAMA consortium after the debriefing activities

4.7 **General assessment**

During the pilot in Vicenza, the mayor's office and his press office followed the activity with interest. Local reporters attended the pilot and interviewed operators in the control room to get their impressions of the system. Despite some malfunctions or some functions that could potentially be improved, the city of Vicenza has expressed its keen interest in experimentation

by asking when the system can be used operationally in their civil protection system in the context of disaster management.

After the debriefing activities, the project technical partners worked in an attempt to satisfy the requests and suggestions of the end-users that emerged during the final project pilot, where they were not too time-consuming or would not change substantially the data flow of the platform.

Among the changes made there is the addition of the legend relating to the population in the **Authoring tool** and the visualization with icons of different colors of the POIs relating to the disaster management category.

As far as the **Citizen app** is concerned, the suggestions of the end-users have been fully accepted, in particular by preparing a specific section for the reports sent and making the management of audio files more functional.

As for the **AR app** the forecasted flood level display has been improved.

This attitude once again demonstrated the commitment of the consortium and the constant effort to meet the needs of the end-users to create a system that is of real support in emergency management and that adapts and is as close as possible to the real situations.

5 MEDIA PRODUCTION PLANNING: CORFU DOCUMENTARY

5.1 User Story

In the attempt to keep a stringent approach throughout the whole project, DW decided to stick to the user story developed in an earlier stage of the project:

Natascha is a documentary film maker for DW. She has been assigned to make a documentary on the island of Corfu – i.e., the TV program envisioned and described in D 6.2. A quick look at her budget tells Natascha the production needs to be rather economical; specifically costs for background research and location scouting should be kept at a minimum. At the same time, DW is looking to produce an informative program that meets journalistic standards. Natascha is also quite ambitious. She wants to be well prepared, collect a lot of information, and set up everything the right way without spending too much money. Enter xR4DRAMA, the extended reality and multimodal data situation awareness platform that also caters to media production planners – and will tell Natasha (and her team) what designated shooting sites on Corfu look like, plus what is going on there at a specific time.

Natasha is, of course, a fictitious person and simply introduced here for the purpose of a short, concise user story. In the real world, members of DW Innovation and xR4DRAMA partners took on Natascha's role and that of her team members.

5.2 **Final implementation of media pilot**

The sites for the final testing of the second prototype were the old town of Corfu and DW's headquarter in Berlin. The reasons for choosing Corfu as the site of the fictional media production have already been described in D 6.2. And the reason for choosing DW's headquarter in Berlin is obvious: This is where media productions are planned and prepared. Here steps 1 and 3 were executed.

Figure 31: The old town of Corfu and the Old Venetian Fortress

Step 2, in which the location scout gathered information and data, took place again in the old town of Corfu, specifically on Kremasti Square, Spianada Square and the Old Venetian Fortress.

5.3 **Agenda of Activities**

The agenda for the testing of the final xR4DRAMA prototype was the following:

Step 1 in Berlin

- technical setup of laptop and XR gear
- download and initial startup of the latest project software (Windows applications of Authoring Tool including VR Tool) including first testing
- preparation of docs and spreadsheets (requirements, expected performance, notes, talking points)
- execution of step 1 (create project, define area of production, check on the automatically gathered information, create tasks for the location scout)
- more system test runs, evaluation and documentation

Figure 32: DW's xR4DRAMA team member Alexander Plaum takes pictures of Ioannis Kapodistrias Statue at Spianada Square on Corfu

Step 2 on Corfu

- technical setup of laptop and other gear (smartphone, 360° camera)
- download and initial start of the latest project software (Windows applications of Authoring Tool + VR Tool, AR app for Android and iOS) and first run
- preparation of docs and spreadsheets (requirements, expected performance, notes, talking points)
- execution of step 2 which means: executing the tasks allocated to the location scout including checking and creating POIs, taking photos (i.e. for photogrammetry, 360° photos), searching for locations for the production, placing of the production set ups in the AR mode at potential sites of production, checking and gathering of information
- more system test runs, evaluation and documentation

Figure 33: Photo of the predefined production set up placed on Spianada Square via the AR mode of the smartphone app

Step 3 in Berlin

- technical setup of laptop and XR gear
- preparation of docs and spreadsheets (requirements, expected performance, notes, talking points)
- execution of step 3 including checking on information and documents gathered by the location scout, entering the site of production in VR mode, checking 360° photos in VR mode, placing of predefined production set ups in VR mode etc.
- more system test runs, evaluation and documentation

Figure 34: Screenshot of the predefined production set up placed on the 3D model in VR mode

Aside from extensive testing by DW's xR4DRAMA team, the final prototype was also presented to and thoroughly checked out by friendly users in Bonn, Bremen, Berlin.

5.4 **Pilot Process and Outcomes**

This chapter describes the process and outcomes of the pilot with regard to the concept of situation awareness while following the agenda of activities described in chapter 5.3.

5.4.1 **Situation Awareness in the final test run**

As already mentioned, and discussed in D6.1 and also described in various other xR4DRAMA publications, the media use case is all about generating situation awareness.

Throughout the project, we sticked to the concept of three different levels of situation awareness developed in an early stage of xR4DRAMA: Simple Mode, Advanced Mode, and Immersive Mode.

In the following sections the three modes are not only described – the performance of the final prototype with regards to each level is also evaluated.

5.4.2 **Initial Mode (Situation Awareness Level 1)**

This mode is available after a project has been created and the area of production has been defined by the users. Like in the first evaluation, this area was the old town of Corfu (including the site of the Old Venetian fortress).

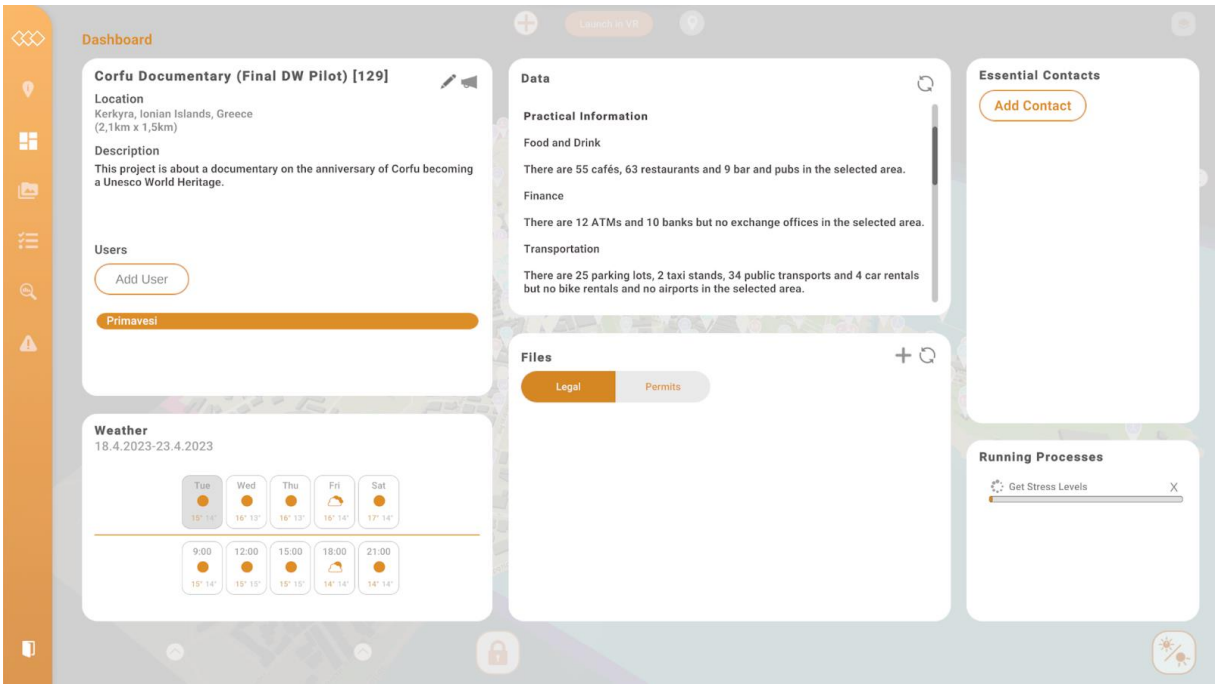


Figure 35: Screenshot of the dashboard in Situation Awareness Level 1

During the final test run, the initial mode worked fine. A project could be created, users added, an area of production defined, and a lot of helpful information was gathered automatically (via crawling of various sources) and shown on the dashboard.

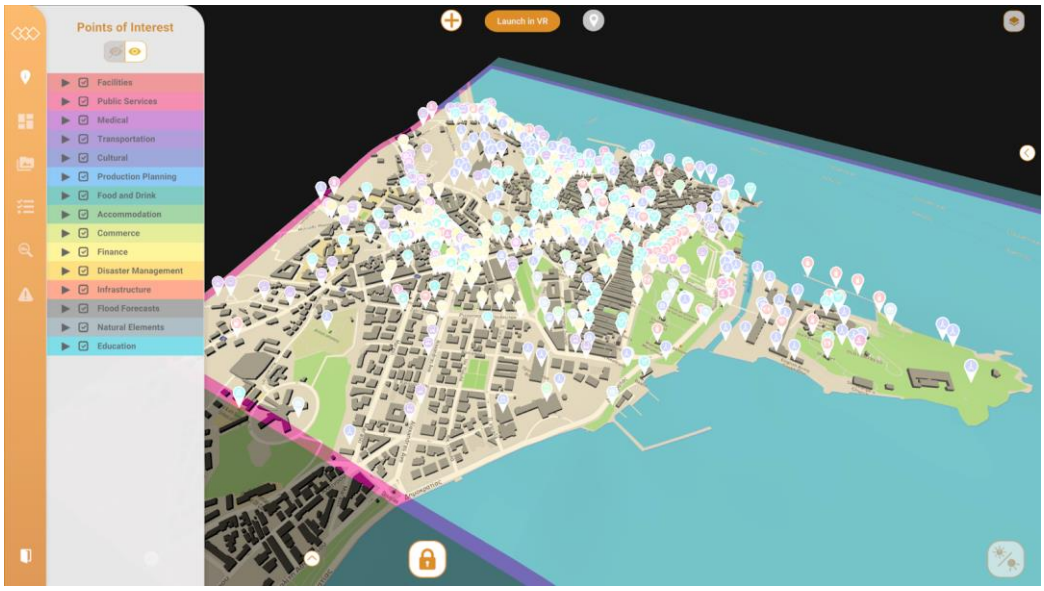


Figure 36: Screenshot of the map in Situation Awareness Level 1

Displayed on the production area map, various points of interest collected from multiple sources provided a comprehensive overview of what to anticipate in this specific neighbourhood. Users were granted an initial glimpse of the on-site conditions, enhanced by the grey blocks representing buildings.

5.4.3 **Enhanced Mode (Situation Awareness Level 2)**

In this more sophisticated mode of the platform, all assets and pieces of information collected and uploaded by the location scout should be available in the system: new POIs, documents, photos, audio recordings etc.

During the final test run, everything worked fine. Every bit of data collected on site in the old town of Corfu (and attached to POIs in several cases) could be accessed by the production team in Berlin.

5.4.4 **Immersive Mode (Situation Awareness Level 3)**

This mode represents the highest level of situation awareness available for the production team at DW's headquarter in Berlin while planning a production at a site thousands of kilometres away. It allows users to explore a location in 6DoF mode.

The experience starts by initiating the VR mode of the platform. It actually works right from the beginning, but only makes sense when all location scout data is available. The 3D models – which can be fully appreciated and explored in this mode – are based on drone footage or smartphone photos.

Figure 37: Screenshot of the 3D model of the Kremasti Square on Corfu in VR mode

During the final prototype test in Berlin, this mode worked fine. It was possible to explore the defined area in full VR mode (walking and flying, s image below). Media files (such as 360° photos) could be inspected immersively, audio files of the soundscape on site could be replayed, and predefined production set ups could be placed at will (see last image in chapter 5.3).

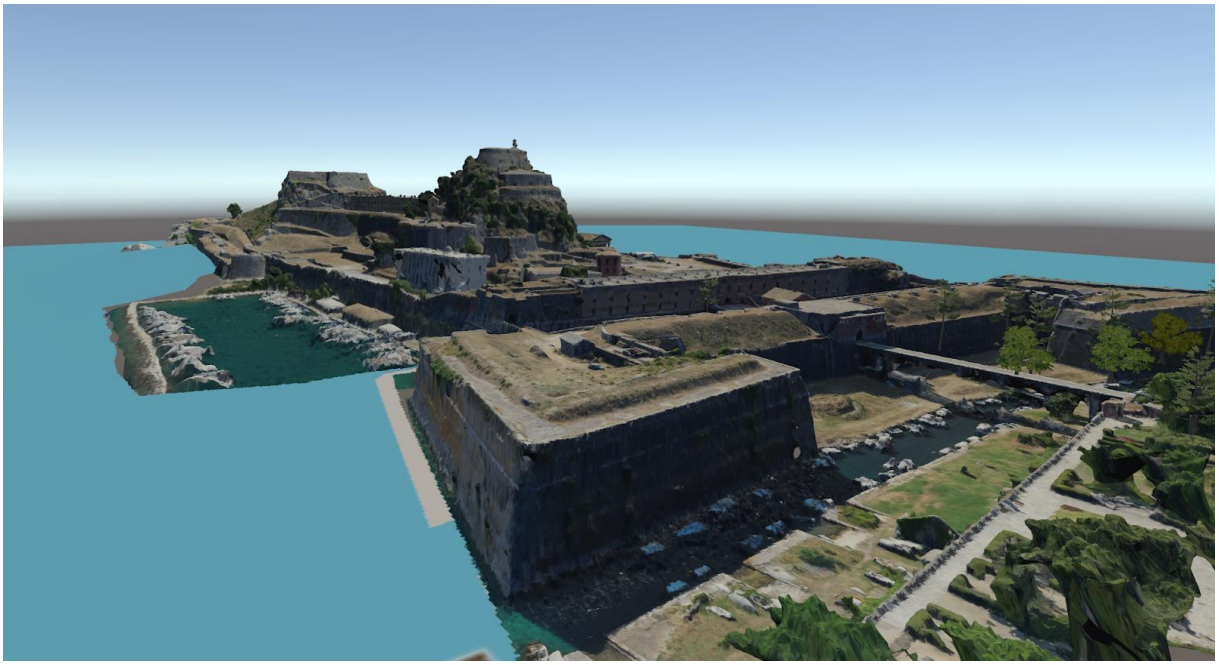


Figure 38: Screenshot of the 3D model of the Old Venetian Fortress in the fly mode

5.5 **Final system status**

During the course of the project the use case partners defined and refined a set of requirements for xR4DRAMA. In the following section, you will find a list of the use case specific requirements and their status in the final prototype. Ex ante: 100% of the requirements were accomplished.

Use Case Specific Requirements

Info-ID	Category	Name	Description	Implementation status/Comments
PUC2-01	Environmental factors	Noise pollution	identification of possible sources like busy roads or highways, crowds of people, factories, airports, railway stations, railway tracks	manual edits possible via POI including uploaded sound recordings
PUC2-02	Environmental factors	Light Pollution	identification of possible sources like streetlights, ads etc.	manual edits possible via POI
PUC2-03	Accessibility	Parking	availability of parking	automatic aggregation implemented (parking lots displayed as POI)
PUC2-04	Legal Issues	Necessity of filming permit on the ground	necessity of a permission for filming on the ground with a crew	implemented, dedicated section on the dashboard of the authoring tool
PUC2-05	Legal Issues	Necessity of filming permit in the air	type of permission for filming with drones, possible restrictions for filming	implemented, dedicated section on the dashboard of the authoring tool

PUC2-06	General information	General information on site/buildings	textual information on specific sites/buildings in the area of interest	automatic aggregation for some buildings via OSM data, manual edits possible, buildings can be annotated via POI feature
PUC2-07	Environmental factors	solar altitude during the day	simulation of the course of the sun during a day	implemented (via 'sun slider')
PUC2-08	Facilities	Power	availability and accessibility of power outlets	implemented
PUC2-09	Facilities	Bathrooms	availability and accessibility of bathrooms	automatic aggregation via POI, manual edits possible
PUC2-10	Facilities	Restaurants, Cafés etc.	list of/indication of available places to eat/drink	automatic aggregation via POI, manual edits possible
PUC2-11	Facilities	Props & Gear	Possibility to put props/decoration/etc. in the environment	implemented
PUC2-12	Simulation	Drone flights	Possibility to simulate various flights of drones in VR	implemented
PUC2-13	General information	Travel- and Security Advice	Information on the security situation in the designated country	implemented

PUC2-14	Environmental factors	Noise situation on site	the noise situation on site recorded by the location scout via a Smartex device as mp3-file	implemented; audio files can be uploaded/attached to POIs

Table 5: PUC 2 specific requirements

5.6 **System evaluation**

This chapter is dedicated to the evaluation of the final prototype. There was extensive testing by DW's xR4DRAMA team members as well as friendly users, who represented several important DW departments (production, news, innovation unit, DW lab etc.) and also filled out a questionnaire.

All in all, the system was thoroughly explored and tested by nine people (including Thomas Burbat, senior stagehand at DW with decades of experience in planning and preparing productions of all sizes and Marie Kilg and Daniela Späth, heads of DW Lab and experienced content innovators).

As mentioned in D 6.3, large scale quantitative testing would have made no sense due to the complexity of the use case and the need to understand:

a) media productions/journalism;
b) immersive technology;
c) the xR4DRAMA software application kit (desktop and mobile).

A quote by Henning Ott, experienced cinematographer, drone operator and video editor, puts the platform experience in a nutshell:

"xR4DRAMA enables me to obtain necessary information in a time and resource efficient way. And this information does not only consist of basic facts, but also of spatial contexts. It gives me a sense of a place, so that I can not only make decisions on an informal level, but also on an emotional/creative level, which would otherwise only be possible if I were on site."

Gönna Ketels, an experienced reporter and video/documentary producer at DW, states: “The platform provides a more comprehensive impression of a location. I usually cannot visit locations before filming, but with xR4DRAMA it is as close as possible to being there and getting all the information I need. xR4DRAMA also saves users a lot of time, because everything is accessible via the same tool.”

As the graph below shows, the vast majority of testers thought of xR4DRAMA as a “good” tool.

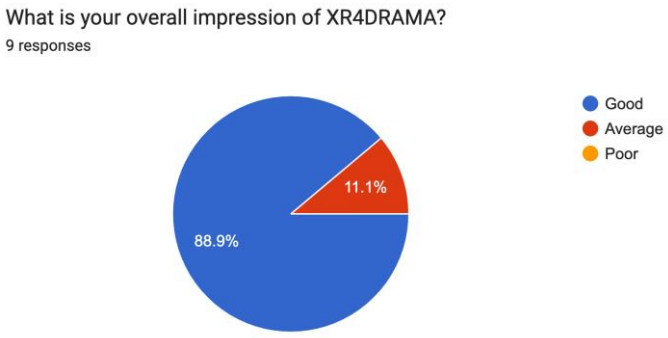


Figure 39: Graph “overall impression” from PUC 2 questionnaire

A majority also found it easy to get familiar with the system and learn how to use it (55,6% rated it as “good”). The same applies to the performance of the system (55,6% rated it as “good”).

The test candidates saw the following advantages when comparing the platform to other tools usually used use to prepare a production:

“xR4DRAMA combines the functionality of different tools I am normally using during a production.”
“It gives you an overview of a location like no other tool”.

“It's a one-stop-shop for location scouting and production prepping.”

The next graph shows the importance of the different features to the users. It underlines that the consortium made the right decision by creating the tool around a map.

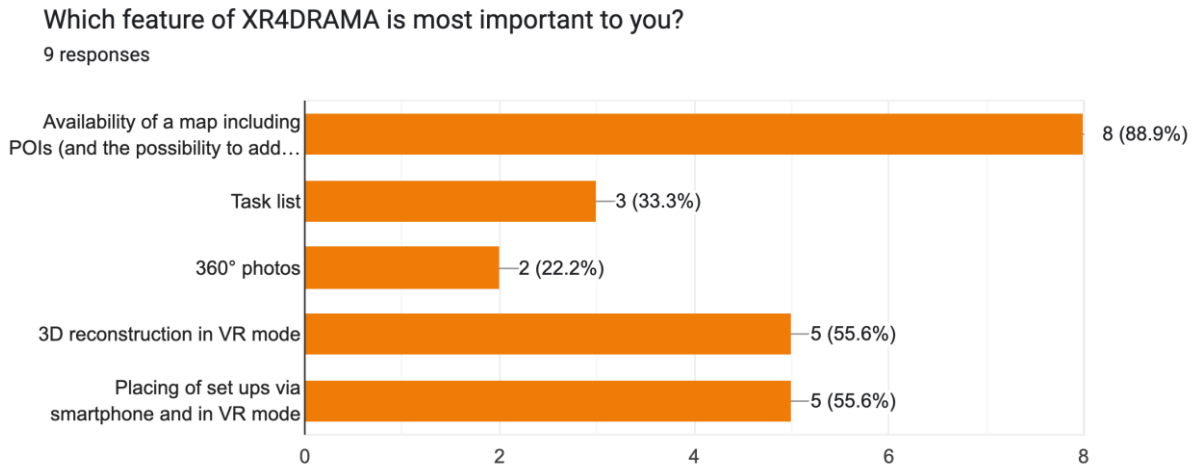


Figure 40: Graph “most important feature” from PUC 2 questionnaire

All users also thought of xR4DRAMA as a truly innovative tool. For very different reasons:

“It increases situation awareness by combining relevant information and different kinds of media (360° photos, 3D models, AR setups) in a map-based way that also includes task management.”

“It uses state-of-the-art technology to solve real problems for real people. The potential savings in cost, energy and effort are huge. It's a prime example of creative tech for good.

“I've never experienced anything like this before! I like the idea of using VR technology for location scouting. This is really new to me, and I find it very helpful!”

“It seems to be the first time that a tool combines so many technologies (maps, 3D models, XR, text generation, IoT etc.) to increase situational awareness.”

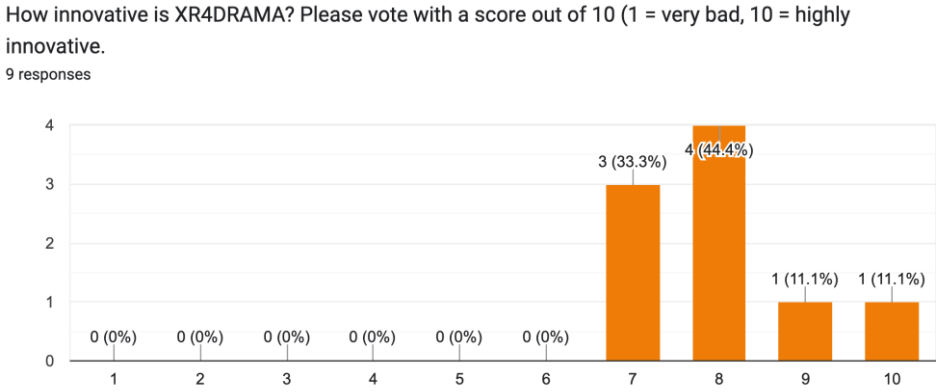


Figure 41: Graph “innovation rate” from PUC 2 questionnaire

A question regarding a final rating users would give xR4DRAMA led to this very positive result:

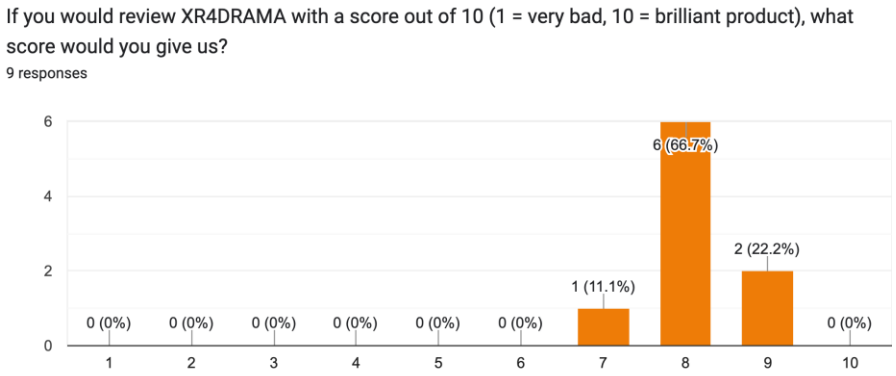


Figure 42: Graph “xR4DRAMA score” from PUC 2 questionnaire

There were also a couple of critical remarks, mostly asking for more polished UX/UI, especially in the authoring tool.

Regardless, “xR4DRAMA could take location scouting and fixing for film productions to a whole new professional level and save producers time and money and avoid negative surprises on the ground.”

And the users also liked the platform for another reason: “We humans are spatial beings and perceive our surroundings in three dimensions. Therefore, it only makes sense to use the spatial and innovative technology XR for spatial topics where the situation on site matters.”

This proves that the consortium's decision to use XR technologies for media production planning at the very beginning of the project was also a good call.

5.7 **General assessment**

During the last two and a half years the consortium was able to create a solid and working prototype for the media use case in xR4DRAMA. As foreseen in D6.3, it actually has developed into a feature rich XR production planning platform. With the map as the hub of the whole tool - on the desktop, in the AR app and in VR mode.

Especially the smartphone app made a huge step forward during the course of the project when it comes to functionality, features and usability. The developers also surprised us with small, but very helpful extra features like AR measurement. The authoring tool can be called a solid, functional, and more than sufficient prototype. There is, however, room for improvement regarding UX/UI (as also stated during the user tests).

Having mentioned all this, xR4DRAMA definitely increases situation awareness while preparing a production remotely. This is due to the smart combination of many different features, and not only the obvious ones like 3D models in VR: There is the map with a lot of POIs for a first overview – and all kinds of media files (including 360° pictures) which give a really good impression of the situation on site. The possibility to place virtual production setups in physical space (via the smartphone app) is also a big asset. These models also play an important role when it comes to creating a deeper level of immersion in VR – in combination with the big 3D models created via drone image photogrammetry. The latter helps remote production staff get a very good, basically real overview of a production site.

With the virtual production setups in place, it is also possible to plan camera positions/ angles and lighting in a very precise way, especially with regard to the day/night/sunlight toggle that is implemented in all modes of the xR4DRAMA desktop and VR tool.

xR4DRAMA is both innovative and unique in the way it combines data from a plethora of sources to boost situation awareness for media professionals – and thus visibly facilitates and improves production planning.

6 FINAL STATUS SYSTEM IN TERMS OF SYSTEM AND GENERAL REQUIREMENTS

In the following section, you will find a list of system and general requirements and their status in the final prototype. Ex ante: about 87.1% of the system requirements were fully or partially accomplished (94.7% of the system requirements reported in D6.2 were completely or partially fulfilled and among those not implemented there are requirements that the end-users had given a low level of priority; 9 of the 12 additional requirements, defined following the evaluation relating to the first cycle pilots and in any case with a low priority assigned, have been implemented) and 100% of the general requirements were accomplished.

System Requirements

Info-ID	Name	Description	Implementation status/Comments
SYS-1	System dashboard and admin interface	An application interface that allows for high-level operators to access the xR4DRAMA system from the control room	Implemented
SYS-2	End-user interface	An HCI that allows end-users to easily communicate with the system	Implemented
SYS-3	Location ingest	Possibility to define a specific location	Implemented
SYS-4	Location-query	A functionality of the system that allows end-users to initiate a query regarding a specific location in web- and cloud services	Implemented focusing on OSM
SYS-5	Aggregation of query status and results	The capacity of the system to observe the query and aggregate the identified content (e.g., videos, images, text) in an organized manner (categories, clusters, order)	Partially implemented; text and visual analysis results are combined by text generation in POIs as well as the event timeline
SYS-6	Immersive visual representation	A functionality that visualizes the location and additional information to enhance situation awareness (e.g., VR, AR)	Implemented

SYS-7	Initial situation awareness for control room staff	System can present available information in a spatial view ● Bird's Eye/map ● PoV	Implemented
SYS-8	Multilingual text generation	The system will provide relevant information in the user's language of choice (English, Italian or German)	Partially implemented; text generation service supports English and Italian, but it is not user configurable.
SYS-9	Edit query results	Control room staff must be able to filter, cluster, annotate and amend the query results	Implemented. POIs can be clustered, annotated and amended.
SYS-10	Add own data	Control room staff can add images, videos, models or scans to improve data, or change certain data points that might not have been available	Implemented but some type of media cannot be added (photogrammetric scans, ambisonics audio)
SYS-11	Communicate own data	Control room staff can send data or tasks (assignments) to other users (e.g., location scouts, first responders)	Implemented
SYS-12	Mobile application	An application that allows for operating the system in and from the field	Implemented
SYS-13	Citizen application	An application that allows citizens to send video, images and audio messages, reporting flooding emergencies (PUC1 only)	Implemented
SYS-14	Remote access to initial situation awareness	The capacity of the system to grant remote users (e.g., location scout) access to a Level 1 situation awareness representation (partly or in total) via the mobile application. Citizens (PUC 1 only) should receive useful information such as alerts, risk zone warnings about areas at risk, position of safe areas, sand-bag distribution, shelters.	Implemented

SYS-15	Information ingest	A functionality that allows the location scout to update information about a specific location and to add videos, images, text as well as data from other sensors	Implemented
SYS-16	System updates	The system processes new input (e.g., from location scout/first responders) and updates previous results and representations	Implemented
SYS-17	Enhanced situation awareness	The updated data is used to create an enhanced version of the scene graph containing all available relevant content and information	Implemented
SYS-18	Immersive situation awareness	The system provides functionalities that further increase situation awareness and can be utilized by control room staff at will • 6DoF immersive mode • possibility to define camera positions • possibility to simulate camera movements • possibility to simulate solar altitude or darkness and specific weather conditions	Generally implemented, but lacking the possibility to define camera positions/movements
SYS-19	Export situation awareness representation	The capacity of the system to export visualizations (and other immersive representations) on demand	Not implemented (but it was a low priority requirement as it is possible to get visualizations via the common screenshot-tools implemented in Windows)
SYS-20	Global Search *(new requirement, not defined in D6.2 but emerged from the 1st*	allow users to search for places and assets inside a project	Implemented

	evaluation cycle)		
SYS-21	User management system *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	allow users to have different roles and permissions; e.g. a project lead in the control room should be able to see all tasks, but location scouts only need to see their assignments; project leads should also have a lot of editing permissions (incl. project deletion), while it is probably safer if simple project members stick to a 'read only and send some updates' mode	Basic user management implemented
SYS-22	OCR for uploads *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	implement an (open source) AI library that enables the system to recognize and store letters/words on uploaded images	Not implemented but not relevant (it was a requirement with very low priority)
SYS-23	Content filters *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	implement content filters in the file browser; allow user to display crawled content OR scouted content OR both; allow user to display media files based on visual analysis (scene recognition classes; building and object localization classes)	Implemented
SYS-24	POI fav list *(new requirement, not defined in D6.2 but emerged from the 1st*	implement a POI favourites list, as users tend to find it difficult to remember/recognize important POIs when there are a lot of POIs and/or massively populated POI categories; ideally, the platform should offer multiple fav lists with custom names	Not implemented: at the stage it was identified as useful feature it was not possible to implement and support it in all end-user tools

	evaluation cycle)		
SYS-25	POI indicators *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	Implement icons/visual aids that tell users if a POI is connected to a) a media file and/or b) a comment and/or c) a task	Implemented
SYS-26	Asset location teleporter *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	In the file browser, implement a feature/icon that takes users to the place where an asset was created	Implemented
SYS-27	Locate users *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	Allow users to see each other's locations across all xR4DRAMA applications	Implemented
SYS-28	XR scale *(new requirement, not defined in D6.2 but emerged from*	Implement a general scale reference, e.g. a (fully rendered) dummy avatar representing a human who is about 1,75m tall.	Implemented

	the 1st evaluation cycle)		
SYS-29	XR measuring tape *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	Implement measuring feature in the AR mobile app (e.g.: Point A to Point B = 2,5m)	Implemented
SYS-30	Overview *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	Allow users to view the entire VR model (selected area) in a smaller scale to get a better overview	Implemented
SYS-31	VR tutorial *(new requirement, not defined in D6.2 but emerged from the 1st evaluation cycle)*	Implement a basic VR tutorial, as very few users are used to working in this mode	Not implemented

Table 6: System Requirements

General Requirements

Info-ID	Category	Name	Description	Implementation status/Comments
G-01	Accessibility	Transportation	quality and type of road (highway, street, path), distance to railway station and airport, public transport	implemented, revised after MIRO exchange
G-02	Geography, Surroundings	Buildings, Monuments	the shape, look and size of buildings, the purpose of buildings	implemented, revised after MIRO exchange
G-03	Geography, Surroundings	Landmarks	indication of high voltage lines, windmills, and other landmarks	implemented, revised after MIRO exchange
G-04	Geography, Surroundings	Roads, Railroads	indication of roads, highways, railroads	implemented, revised after MIRO exchange
G-05	Environmental factors	Weather information	basic weather information through the year or a specific period of time	implemented

Table 7: General Requirements

7 CONCLUSIONS

In conclusion, the overall xR4DRAMA system has shown to have progressed a lot in this last year of the project, to meet the needs and requirements of end-users in both fields (disaster management and media planning).

The user requirements in most cases were successfully fulfilled by the system, in the management of the different scenarios of disaster and media planning.

The pilots showcased the effectiveness of the xR4DRAMA system in addressing the challenges faced in the use cases, providing real-time information, and improving the accuracy of decision-making processes.

The strengths of the system have emerged not only in the individual components and functions, tailor-made to facilitate first responders, disaster managers, media planners and location scouts work, but in the fact that these functions are all available in an integrated system, which makes the approach very innovative and open the way to future developments.

Moreover, the xR4DRAMA system, with few use-case specific adaptations, has proved to be very versatile, providing solutions to very different case studies with very specific needs.

A APPENDICES

A.1. OBSERVATION SHEET (PUC1)

PUC1 – Disaster Management evaluation pipeline

Phase 1 (UC_1) - pre-emergency (control room)

The pre-emergency phase, before the occurrence of the flood, focuses on forecasting models.

Authoring tool

	ACTION	EVALUATION RESULT
1.	The operator logs in	Action correctly executed
2.	The operator creates a project by selecting an area and entering the necessary information	Action correctly executed
3.	The operator designates the collaborators	Action correctly executed
4.	The operator views the various GIS layers: generic (e.g., public services, transportation, cultural site, natural elements, disaster management, infrastructures ...)	Action correctly executed but the POIs in different categories are visualized with the same grey icon, not facilitating easy reading for people in the control room
5.	The operator views the various GIS layers: use case specific (e.g., flood risk maps, flood forecasts)	Action correctly executed but in order to view the layer, the operator must know its exact name: there should instead be a drop-down menu with the type of layer (risk, velocity, water depth) and the most recent run relating to the selected quantity is automatically displayed (together with the date of the run)
6.	The operator displays the information about the potential presence of people, cultural or natural sites in areas at risk (result of intersecting the data relating to the flooding scenarios with those relating to the distribution of the population and sites of interest)	Action partially executed. The population layer, without a legend, is unusable and the other elements are displayed in their entirety within the project area: they are not the result of an intersection with the actual expected flooded area
7.	The operator views the various sensor measures (e.g., water level) available	Action correctly executed, but in the case of forecasted value it would be more useful to display the maximum value in the run in the pop-up and not the value of the first-time step
8.	The operator views the information derived by satellite image services	Currently there is the possibility of viewing satellite images but their resolution with respect to the use case area of interest is insufficient to add information and increase situation awareness

9. The operator views the reconstructed 3D model	There are still some difficulties in the automatic positioning of the 3D model: in some cases, it has to be repositioned manually
10. The operator views the automatically created task list based on the Civil Protection Plan actions and the relative activation threshold (result of the Decision Support System)	Action partially executed; multiple tasks of the same type are created (at each instant in time that the level in the river crosses the threshold?). It is then not possible to assign them to the first responders on the field
11. The operator creates generic tasks for the first responders	Action correctly executed

VR Collaborative tool

1. The operator launches the VR of the area	Action correctly executed
2. The operator views the 3d reconstruction of the area in two ways: at ground level and from an aerial perspective (with a high level of definition)	The definition of the 3D has been evaluated unsatisfactory by the end users for a real use in emergency
3. The operator selects the POIs he wants to view (deselected by default)	The POIs are sometime hidden by the model and not selectable
4. The operator explores the area in VR mode - drone flight	For an inexperienced user it is sometime difficult to grasp the remote controller. In one case the controls were not operable

Phase 2 (UC_2) - during crisis, information by citizens and first responders

At this stage it is essential to collect data from the territory, both thanks to the help of first responders in the field and thanks to citizens who can report flooding emergencies and critical situations in the territory, elements that must be considered in planning intervention actions.

Authoring tool

1. The operator displays the information arriving from citizens as result of the visual analysis, incl. images (in the POI category "Disaster Management" – subcategories: Flood reports, Humans in danger, Animals in danger, Infrastructures in danger, objects in danger)	Action partially executed; the POIs have been correctly created automatically with the summary description of the result of the analysis, but the multimedia content (image, video) has not been attached
2. The operator displays the information arriving from citizens as result of the textual analysis, incl. text messages (in the POI category "Disaster Management" – subcategories: Flood reports, Humans in danger, Animals in danger, Infrastructures in danger, objects in danger)	Action correctly executed; the POIs have been correctly created automatically with the summary description of the result of the analysis

3. The operator creates danger areas based on the incoming information	Action correctly executed
4. The operator creates tasks based on the incoming information	Action correctly executed
5. The operator displays the information arriving from the first responders (the new POIs added, complete with multimedia files)	Action correctly executed
6. The operator checks the status of the tasks visualizing all the different categories (requested, assigned, initiated completed)	Action correctly executed
7. The operator views the task completion reports (text + audio file) sent	Action not executed. In the AT the completion reports by the first responders are not visible

AR app

1. A first responder logs into the app	Action correctly executed
2. A first responder selects the categories of interest to be visualized in the map (the app in use maintains the chosen configuration of selected filters)	Action correctly executed
3. A first responder inserts a POI attaching an image (the uploaded media files can be visualized and modified if needed)	Action correctly executed
4. A first responder inserts a POI attaching a video (the uploaded media files can be visualized and modified if needed)	Action correctly executed
5. A first responder inserts a POI attaching an audio file (the uploaded media files can be visualized and modified if needed)	Action correctly executed
6. A first responder is instructed to verify a report (editing an existing POI)	Action correctly executed
7. A first responder launches the app in AR to be guided to the POIs and see the relative information	Action correctly executed; the end users have highlighted that the distance indicated to reach the POI in AR is that as the crow flies which can be very different from that indicated in navigation mode. It is not a parameter that helps the operator understand which POI (or task) is actually closer to reach
8. A first responder accepts, performs and completes a task (need for simple functionalities that can be learned by the volunteer with a minimum of training)	Action correctly executed

Citizen Awareness app

1. A citizen opens the app	Action correctly executed
2. A citizen displays his/her position on the map to be sure of being correctly geolocated before sending any reports	Action correctly executed
3. A citizen reports a critical issue by writing a text and sending it	Action correctly executed
4. A citizen sends an audio recording to report a flood related issue	Action correctly executed, but end users have reported that the audio files are listed randomly, not in chronological order, and it is difficult to retrieve the last recorded file for sending. Even the files can be hidden by the bar at the bottom of the screen and therefore not selectable
5. A citizen sends an image to report a flood related issue	Action correctly executed
6. A citizen sends a video to report a flood related issue	Action correctly executed, but some video failed to send, and the user is not informed if a size limit was exceeded
7. A citizen checks a summary of his/her sent reports	Action not executed; the function is not available in the app, but end users have reported it as important for understanding which reports have been sent
8. A citizen receives a notification	Action correctly executed
9. A citizen checks the presence of unread notifications	Action correctly executed
10. A first responder notifies citizens	Action correctly executed

Phase 3 (UC_3) – emergency management

The control room needs to assign tasks, check the performed action (by physiological-physical parameters – stress detection), and monitor their execution in real time, guiding the first responder to optimize the performance of his/her action (efficiency and effectiveness, duration) and ensure safety conditions.

Authoring tool

1. The operator creates warnings or dangerous zones based on the incoming information	Action correctly executed
2. The operator creates tasks based on the incoming information and assign them to the teams on the field	Action correctly executed
3. The operator assigns tasks automatically created based on the Civil Protection Plan procedures	Action not executed: it was not possible to assign the tasks

4. The operator displays the information arriving from the first responders (the new POIs added, complete with multimedia files)	Action correctly executed
5. The operator checks the stress level of the operators in the field, sending warnings to the first responders in case of overlaying of specific thresholds	Action correctly executed

VR Collaborative tool

1. The operator monitors the situation in real time (all the POIs available in the Authoring tool but in VR mode)	The POIs were sometime hidden by the 3D model and not selectable

Citizen Awareness app (First responder mode – functionalities to be transferred to the AR app in the final prototype)

1. A first responder logs into the app (first responder mode)	Action correctly executed
2. A first responder activates the RUSA for the acquisition of physiological data	Action correctly executed, but the end users reported the need to restore the connection between RUSA and the phone several times during the trial, to send the physiological data. Moreover, some report the persistence of the same level of stress (with small variations) even with the RUSA device disconnected from the vest

AR app

1. A first responder is instructed to verify a report	Action correctly executed
2. A first responder is instructed to send a report from a specific area	Action correctly executed
3. A first responder is instructed to reach a specific area (using the navigation functionality that allows to avoid dangerous zones)	Action correctly executed
4. A first responder activates the share location function	Action correctly executed; the end users report that distinguishing the operators in the field with different colors would facilitate the identification of the closest operator to ask for assistance in an intervention
5. A first responder is notified when a task is assigned to her/him	Action not executed; the functionality is not present in the app, but it is indicated as very important by the end users

6. A first responder performs and completes an assigned task	Action correctly executed
7. A first responder monitors his/her stress level and any warnings in this regard automatically generated by the system	Action correctly executed
8. A first responder launches the app in AR to check the forecasted flood levels	Action correctly executed; end users report that sometimes the water is blue, sometimes inky dark
9. A first responder launches the app in AR mode to simulate the positioning of the Aquadike barrier	Action correctly executed; the end users report that the iOS version, if there are moving objects in the frame (e.g. cars) does not allow to position the 3D element, asking to scan the ground to identify a flat surface

A.2. INFORMATION SHEET AND CONSENT FORM (PUC1)

PARTICIPANT INFORMATION SHEET

General Information

You have been invited to participate in a research conducted by xR4DRAMA's Consortium coordinated by CERTH (Centre for Research and Technology – Hellas). xR4DRAMA is an EU funded project (Grand Agreement No.: 952133, Call: H2020-ICT-2019-3, Topic, ICT-55-2020 - Interactive Technologies, https://cordis.europa.eu/project/id/952133) concerning a solution that will improve the situational awareness of those user groups who are responsible for handling disasters, man-made crises, or public events. This document provides you with all the necessary information you need to completely understand why this research is taking place and what it involves, before providing us with your consent for participation.

xR4DRAMA project aims to create a solution that will improve the situational awareness of those user groups who are responsible for handling disasters, man-made crises or public events. The groups range from first responders, local authorities and security forces to media companies and event planners. Situational awareness is crucial for them to execute tasks efficiently, plan things and take the appropriate decisions.

xR4DRAMA's research started in November 2020 and will be completed in April 2023 – more information can be found at the project's website https://xr4drama.eu/.) and is run by 7 partners across Europe:

Partner	Short name	Country
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	CERTH	Greece
DEUTSCHE WELLE	DW	Germany
NUROGAMES GMBH	NURO	Germany

Partner	Short name	Country
UP2METRIC IDIOTIKI KEFALAIOUCHIKI ETAIREIA	U2M	Greece
UNIVERSIDAD POMPEU FABRA	UPF	Spain
AUTORITA' DI BACINO DISTRETTUALE DELLE ALPI ORIENTALI	AAWA	Italy
SMARTEX S.R.L.	STX	Italy

xR4DRAMA results will be validated through 2 field tests in each of the two pilot use cases (PUCs):

- Disaster Management
- Media Production

Description of Research

	Description of research/ Data Collection
Aim of the research study	xR4DRAMA system provides first responders with important information to act safe and efficiently during an emergency, reproducing in real time the actual event inside the control room to allow for well-informed and efficient decision making. xR4DRAMA system detects the stress level of the first responders, send them warnings, and allows them to be guided in the action on site in safe conditions (e.g., indications on the best routes to reach the area of intervention or to avoid dangerous areas/elements).
Time and Location	The pilot takes place in Vicenza on 7-8 March 2023
How you will participate	**Before:** Prior to each demonstration a briefing session will take place in order to inform all involved participants about the research activities that are going to take place as well as what is going to be needed from them in the field of the demonstration in order to execute the Pilot Use Case scenario. In the same manner, a debriefing session is also going to take place after the execution of the demonstration in order to recap all actions and proceed with the evaluation of the system. **During**

	Description of research/ Data Collection
	You will join the relevant activities, specifically: you will send data (video, images, audio, text, physiological parameters) through your mobile device. **After:** After the end of the activity, your feedback will be collected through: ● Oral questions/interviews – mostly to technical partners participating in the demo in order to see how the technical solution operates during the demo and if modifications will be required. End user partners will also be asked some questions during the pre-evaluation event that will take place prior to the demo and will serve as an opportunity for them to be familiarized with the platform and report any issues resulted. ● Follow up questionnaire – mostly to end user partners involved after the execution of the demo. This will assist the evaluation of the system's ability to operate properly and the feeling of satisfaction for the produced outcome by the end users. ● Observation sheets - mostly to end user partners. This will assist to collect the feedbacks and notes taken by the 'observers' in each of the trial sessions in which the pilot is divided, with the aim to take note of every task performed and the problems occurred.
Is your participation mandatory?	It should be highlighted that your participation is completely **voluntary,** and you can **withdraw** at any time of the process without providing any reason and without any negative consequences for you. For this objective, please contact Michele Ferri (michele.ferri@distrettoalpiorientali.it). After contacting him, you might be asked whether you would like to permanently delete your data or if you consent to continue processing these data. You are also able to raise any objections or lodge a complaint to the relevant DPO/authorities. In addition, you might be asked for the reason why you would like to withdraw from the research, but you are not obliged to respond. *Under no case will the participation be obligatory for any of the employees of the data controller. The employees-data subjects are voluntarily invited to participate in the present research and*

	Description of research/ Data Collection
	they are free to deny any participation. No negative repercussions will follow any withdrawal of the research. You are free to also decide the questions you are going to answer during the feedback session.
Advantages and Risks of your participation	Although there will be no immediate benefits from participating in this research, the outcomes will contribute to enhancing the European Union's exploitation of interactive technologies in disaster management. You will also have the chance to interact with other experts in the field and exchange ideas and inputs, around important issues on Interactive Technologies for the improvement of Situation Awareness. No physical harm, damage or risk is expected to be inflicted on the participants. In all arrangements of this PUC, the Covid-19 restrictions and instructions will be taken into account and be fully implemented. Personal details will not be used during or after the PUCS, other than by the organizers, to contact participants in relation to your participation or if you wish to be contacted about anything after the focus group. Nothing in your responses will be linked or used with their name or any other identifying information. All the recordings will be retained securely by the project team and will not be linked with other identifying information. Access to any personal information you provide, will be limited strictly to the people involved in the research directly (*please check also the exact clarifications given below for the collected data and the security related to them*)
Data Protection Issues	
The type of (personal) data to be collected and the people that will have access to them	Generally, the type of data that will be collected: ● Textual data ● Visual data (images and videos) ● Audio Data ● Physiological data (ECG, Heart Rate, Breathing signal, Breath Rate and movement indicators: accelerometer, gyroscope, magnetometer) The Consortium is only collecting and processing personal data in connection with the research's informed consents within the

	Description of research/ Data Collection
	project's timeframe[5]. Only the absolute necessary data for the collection of your feedback will be collected and processed, respecting the data minimization principle as required to achieve the purpose of this research activity. ● Full name, in order to come back to you in case any further clarification is required ● Professional affiliation, in order to identify for which components, we should contact you for feedback based on your professional background and experience. ● Gender, in order to ensure that our research is gender-balanced ● Contact information, in order to keep you updated on the research's outcomes ● Photographs, video, audio recordings might be acquired, upon your explicit consent during your participation in this research (e.g., audio recordings, video recording of participation in the demonstration, etc.). ● Physiological parameters recordings might be acquired, upon your explicit consent during your participation in this research, to be analyzed by the XR4DRAMA system to detect your stress level (the system is intended for first responders: it allows through the system to assign them tasks based on their actual personal physical status in crisis situations). These data will be strictly retained as confidential and will not be shared outside of the Consortium **UNLESS** it is required to share your information with the European Commission/national authorities as a part of our obligations. Only the project partners in charge of the focus groups will have confidential access to your personally identifiable data. That is the authorized personnel directly involved in the project from AAWA, along with the respective DPO.
The method(s) of collecting and processing data	Data will be recorded through mobile devices and the feedback will be collected through on-line questionnaires. You will use throughout the pilot the SMARTEX equipment (smart vest) to send your physiological parameters and your personal mobile device (smartphone or tablet with ANDROID OS) to install and use the mobile applications developed by the project to send data (photographs, video, text, audio recordings) to the XR4DRAMA platform.

[5] Legal basis: "The data subject has given consent to the processing of his or her personal data for one or more specific purposes" [article 6, 1(a) GDPR

	Description of research/ Data Collection
Where these data will be used.	All this information will be used for adjusting the project's user requirements, system design and used technologies for object/individual detection. Additionally, the information provided, and the demonstration's outcomes may also be used for writing articles in journals or industry magazines, conference presentations and workshops or for further dissemination purposes. No further use of your information will take place without your written permission.
The way security is ensured of your personal data	To begin with, before the start of the research activity, you will be provided with this information sheet and you will be asked to sign a consent form, where all your rights are being described (Section: Participants Rights). All personal data are processed in accordance with the EU General Data Protection Regulation (2016/679). Video, audio, physiological parameters recordings and still imagery will be collected but only for the purposes of an improvement in situation awareness for handling disasters. The recordings of the research activity will be deleted after the end of the project. ***During data collection*** ● Collection of only absolutely necessary personal data (*as described in Section: The type of (personal) data to be collected and the people that will have access to them*) ● Unforeseen sensitive information, or incidental findings which will be treated by us with the utmost confidentiality (*please check Section: Details of any insurance indemnity for the research*) ***After data collection:*** ***a. Storing personal data.*** ● All personal data will be immediately transferred to encrypted and/or secure and password protected servers or devices. If we use a mobile device to record data, we are making sure that it is encrypted and that we are transferring the collected data to secure servers or devices as soon as possible. ● The signed informed consent will be **safely stored** in the premises of the Pilot Use Case leader partners until the **project's end** (October. 2022), in order to be available for demonstration in case of an inspection or an audit. ● The data collected from the field (imagery, videos, geolocation, physiological parameters) will only be

	Description of research/ Data Collection
	temporarily stored in xR4DRAMA's system (until the **demo's/test's end**) in the case of a real-time, online processing is not applicable, due to the technical partners' equipment capabilities. This will depend on which technical partner/ UAV provider is involved in each Pilot Use Case and what their system's capabilities are. ***b. Processing personal data into depersonalized data***. ● Before data can be used, they will be depersonalized, unless there is an explicit agreement with the research participant that says otherwise, e.g., in the case of photos. ○ Pseudonymisation refers to the process of replacing a personal identifier (e.g. name) or semi-obvious identifier (e.g. postal code) with a pseudonym, tag, or coded reference. In this case, the data is altered in that it cannot be related to the particular research participant in whom it came from. For this to be successful, all potential identifiers need to be changed and/or replaced.
Details of any insurance indemnity for the research	In case of incidental findings, meaning that the xR4DRAMA system detects something illegal or unintentionally captures personal data through its sensors (e.g., cameras) that may result to the identification of individuals, one of the following procedures will be followed according to each case: ● In case of a person working for xR4DRAMA has enacted an illegal activity with the sole purpose of testing the system and has been detected by the system, the local practitioner authority (e.g., National Police) will issue this person with a Letter of Commission stating that he or she has performed the action resembling an illegal act for the sole purpose of testing the system. No further action is required. ● In case for a person not involved in any way in the project and engages an illegal activity detected by the system, then the person will be handed over to the present national police who will carry out standard operational procedures determined by regulations on the given case, and all relevant data has to be secured/encrypted and handed over to the police as evidence. ○ Any data collected from video, imagery or other sensors that incidentally may be considered relevant for the identification of individuals not involved in the project will be immediately isolated and erased from all storage devices.

	Description of research/ Data Collection
	It is important to point out that the xR4DRAMA research will not involve any clinical trials.
What will happen to the data after the end of the project	Regarding the hard copies of the collected signed informed consents, after the project's end (Oct. 2022) they are going to be destroyed with paper shredders and no digital copies will be kept. The data collected from the field will be immediately deleted from the system as soon as the demo/test is completed. No copies will be kept in additional servers or communication channels.
Participants' rights	• **Right to information:** you may request information about whether we hold personal information about you, and, if so, what that information is and why we are holding it. • **Right to decline**: you may decline to offer any particular information requested by the researcher • **Right to access:** you may access your data and ask for copies of your data whenever you wish to. • **Right to rectification**: you may ask us to rectify the information you have provided us in case you consider that something is missing or is incorrect. • **Right to erasure**: you may ask us to erase your personal data at any given moment without a specific reason. • **Right to object**: you may request to stop processing your personal data and withdraw from the research at any desired moment. • **Right to data portability**: you have the right to request the transfer of your personal data to another party or directly to you. • **Right to withdraw**: you may have the opportunity to withdraw from the pilot at any time with no adverse consequences
The name and contact details of the Project Coordinator, in case you would like to receive more information of the project	Name: Stefanos Vrochidis (Project Coordinator) Affiliation: CERTH – ITI, Center for Research and Technology Hellas – Information Technologies Institute Address: 6th km Charilaou-Thermi Road, 57001 Thermi-Thessaloniki, Greece Email: stefanos@iti.gr
The name and contact details of the person(s) responsible for the data collection and processing (xR4DRAMA's DPO)	Data Protection Officer: Name: Stella Papastergiou Affiliation: CERTH – ITI, Center for Research and Technology Hellas – Information Technologies Institute Address: 6th km Charilaou-Thermi Road, 57001 Thermi-Thessaloniki, Greece

	Description of research/ Data Collection
	Email: dpo@certh.gr
The name and contact details of another person who can receive enquiries about any matters which cannot be satisfactorily resolved with the Project Coordinator and the person(s) responsible for the data collection and processing	Data Protection Officer Affiliation: Autorità di bacino distrettuale delle Alpi orientali Address: Cannaregio 4314, 30121 Venice (IT) Email: segreteria@distrettoalpiorientali.it

Statement of Informed Consent (Dichiarazione di consenso informato)

I have been invited to participate in a research conducted by xR4DRAMA's Consortium partner AAWA, coordinated by CERTH – Centre for Research and Technology Hellas.

With this informed consent I explicitly confirm that:

(Sono stato invitato a partecipare dal partner del consorzio di xR4DRAMA Autorità di bacino Distrettuale delle Alpi Orientali ad una ricerca condotta coordinata dal CERTH – Center for Research and Technology Hellas.

Con questo consenso informato confermo esplicitamente che:)

☐	I am above 18 years old *(sono maggiorenne)*
☐	I have read the **Information Sheet** concerning the research and I had the opportunity to ask questions for all aspects of the research *(sono stato informato e ho avuto l'opportunità di porre domande su tutti gli aspetti della ricerca)*
☐	I have gained sufficient understanding about the research, the processing of my data and the rights that I have concerning the processing of my personal data, thus agreeing to take part in this study and for my data to be used for the purpose of this study *(ho acquisito una conoscenza sufficiente riguardo al progetto di ricerca, al trattamento dei miei dati e ai diritti in merito al trattamento dei miei dati personali, accettando così*

	di prendere parte a questo studio e dando il consenso all'utilizzo dei miei dati nell'ambito dello studio)
☐	I understand that it is completely **voluntary** to participate in this research and consent to the processing of my personal data. I have at any time the **right to withdraw my consent** to any of the above without announcing any specific reason for my withdrawal and without any adverse consequences *(comprendo che è del tutto volontario partecipare a questa ricerca e acconsentire al trattamento dei miei dati personali. Ho in qualsiasi momento il diritto di revocare il mio consenso senza specificare alcun motivo specifico per il mio ritiro e senza alcuna conseguenza negativa)*
☐	I understand that any kind of information that will be shared in the demonstration is confidential, and I am not allowed to disseminate, share, or use it in any other manner outside the scope of this demonstration (*comprendo che qualsiasi tipo di informazione che verrà condivisa durante la dimostrazione è riservata e non sono autorizzato a diffonderla, condividerla o utilizzarla in qualsiasi altro modo al di fuori dell'ambito di questa dimostrazione*)
☐	I agree that my participation may be audio/video recorded *(accetto che la mia partecipazione possa essere registrata (audio/video))*
☐	I agree that my personal data can be used for contacting me in the context of inviting me in **future events of interest, related to the xR4DRAMA project** (accetto che i miei dati personali possano essere utilizzati per contattarmi nell'ambito dell'invito a futuri eventi di interesse, relativi al progetto xR4DRAMA)

The contact person at AAWA for withdrawal of my participation is:

(la persona di contatto presso l'Autorità di bacino è:)

Name: Michele Ferri

Affiliation: AAWA

Email: michele.ferri@distrettoalpiorientali.it

Full Name *(Nome completo):*

Professional affiliation *(Ente/organizzazione di appartenza):*

Email:

Phone:

Signature of Participant *(Firma)*:

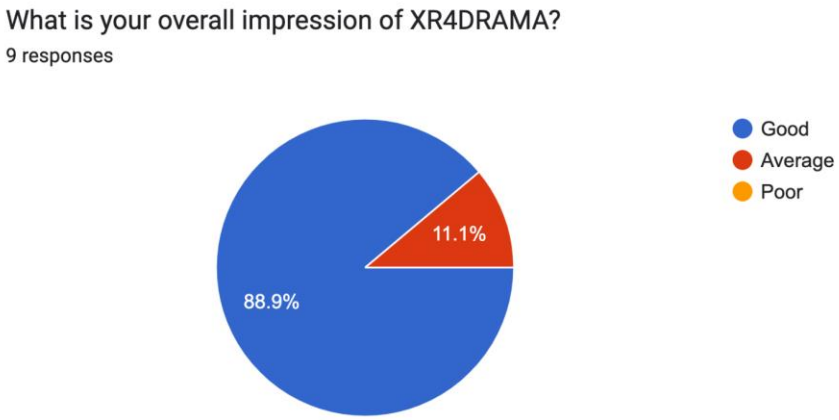
Date:

___/___/20__

With my signature I hereby confirm my participation in the described research and state my voluntary consent to the processing of the personal data in accordance with the information contained in the above-mentioned documents *(con la mia firma confermo la mia partecipazione alla ricerca descritta e dichiaro il mio volontario consenso al trattamento dei dati personali in conformità con l'informativa contenuta nei suddetti documenti)*

A.3. **PUC 2 QUESTIONNAIRE AND RESULTS**

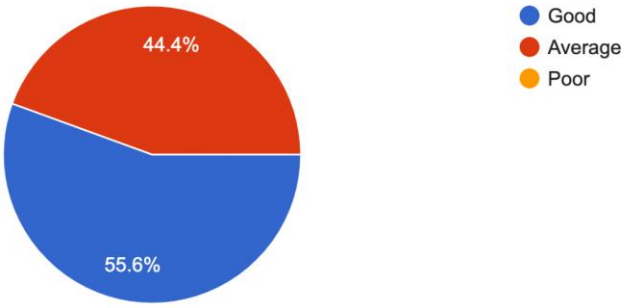
Question 1



Question 2

Is it easy to get familiar with XR4DRAMA and to learn how to use it?

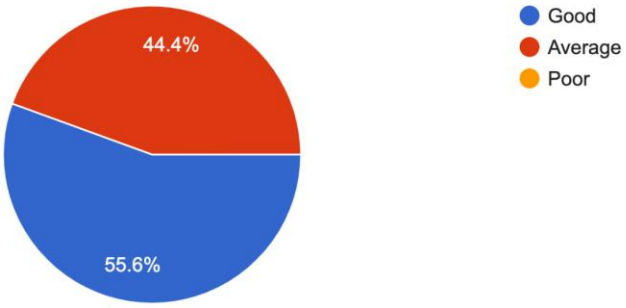
9 responses



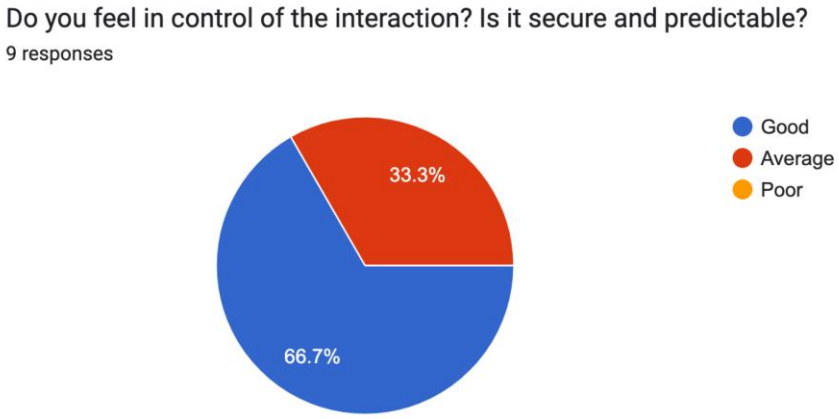
Question 3

How is the performance of the system with regard to speed, reliability and smoothness?

9 responses



Question 4



Question 5

What is the advantage of using xR4DRAMA compared to the tools you are normally using to prepare a production?

Answers:
“xR4DRAMA combines the functionality of different tools I am normally using during a production.”

“xR4DRAMA enables me to obtain necessary information in a time and resource efficient way. This information, however, does not only consist of basic facts, but also of spatial contexts and gives me a sense of a place, so that i can not only make decisions on an informal level, but also on an emotional/creative level, which would otherwise only be possible if i were on site.”

“It provides a more comprehensive impression of a location. Right now, I cannot visit locations before a shoot, but with XR4DRAMA it is as close as possible to being there and getting all the information I need about the place. It could also be a time-saver because everything is accessible via the same tool.”

“It's great to be able to play through different scenarios, like lighting conditions at different times of day.”

“It gives you an overview of a location like no other tool.”

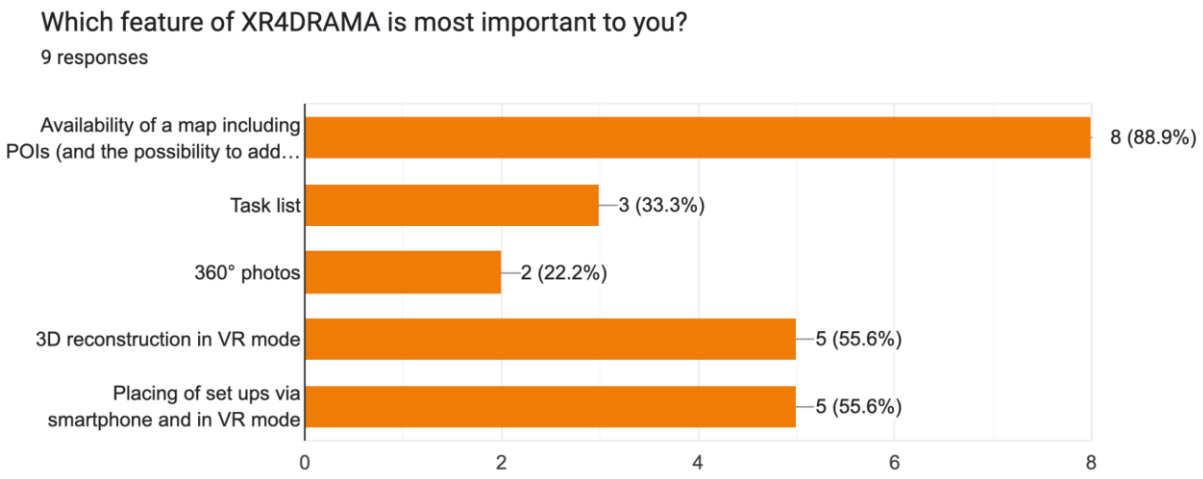
“It's a one-stop-shop for location scouting and production prepping.”

“Preview with real time experience e.g. sunset and sundown.”

“Data can be shared privately and secure with the production team.”

“There are more possibilities to save different notes of any kind.”

Question 6



Question 7
Is there anything you are missing? A feature that should be added to xR4DRAMA?

Answers:
“Nothing.”

“I would find it super useful if xR4DRAMA had a translator built in. Especially for special things like location scouting abroad, where maybe documents, menus, permissions etc. are not in English or the location scout can communicate things better in his native language it would be super helpful to get this information translated directly in the app.”

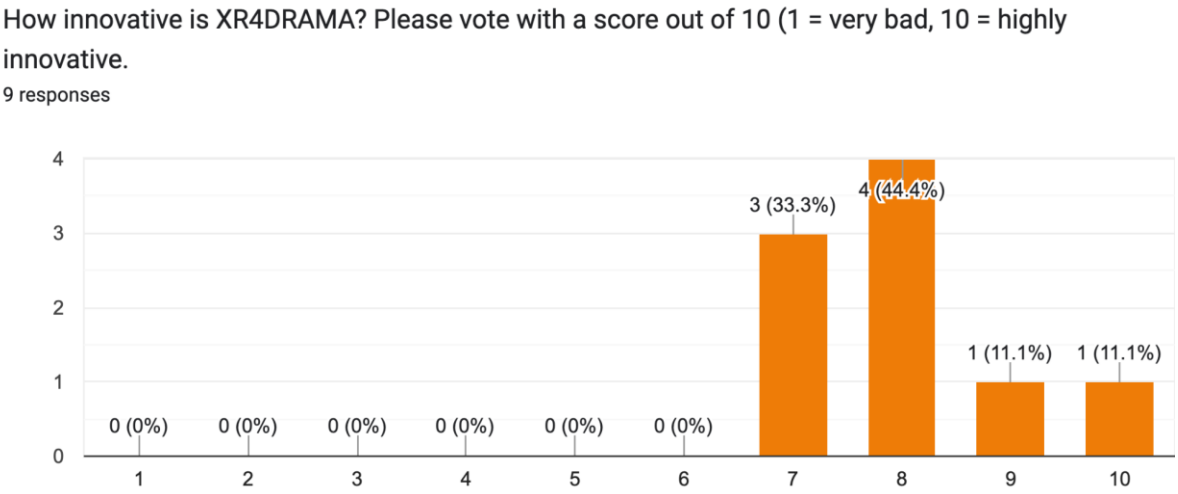
“No.”

“More, more detailed, and more sophisticated info in the dashboard section – and a better design of the section.“

“What's going on on a specific day? Has a specific neighborhood been on the news? What do people talk about on social media? Etc."

“I would like to store POIs which are important for the project like filming locations, accommodations of the crew or recommended restaurants in lists to find them quickly and get a better overview without looking for a specific POI among many.”

Question 8



Question 9

Why is xR4DRAMA innovative?

Answers:

“It's definitely increasing the situation awareness by combining relevant information and different kinds of media (360° photos, 3D models and the placing of setups in AR) in a map-based-way that also includes task management.”

“xR4DRAMA is so innovative because many technologies run together here in such a way that the user does not notice any of this but can work with the "finished" information. In combination with the collaborative approach, it is something that does not exist anywhere else.”

“I am not aware of a similar tool for media productions. It could also reduce a production’s carbon footprint.”

“It uses state-of-the-art possibilities of technology to solve problems for real people. The potential savings in cost, energy and effort are huge. It's a prime example of creative tech for good.”

“I've never experienced anything like this before! I like the idea of using VR technology for location scouting. This is really new to me and I find it very helpful!”

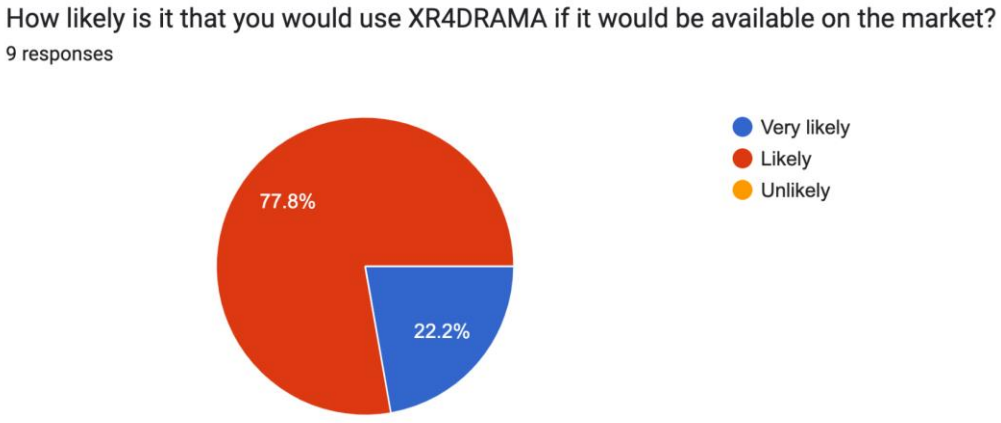
“It seems to be the first time that a tool combines so many technologies (maps, 3D models, XR, text generation, IoT etc.) to increase situational awareness.”

“It is a multifunctional planning tool.”

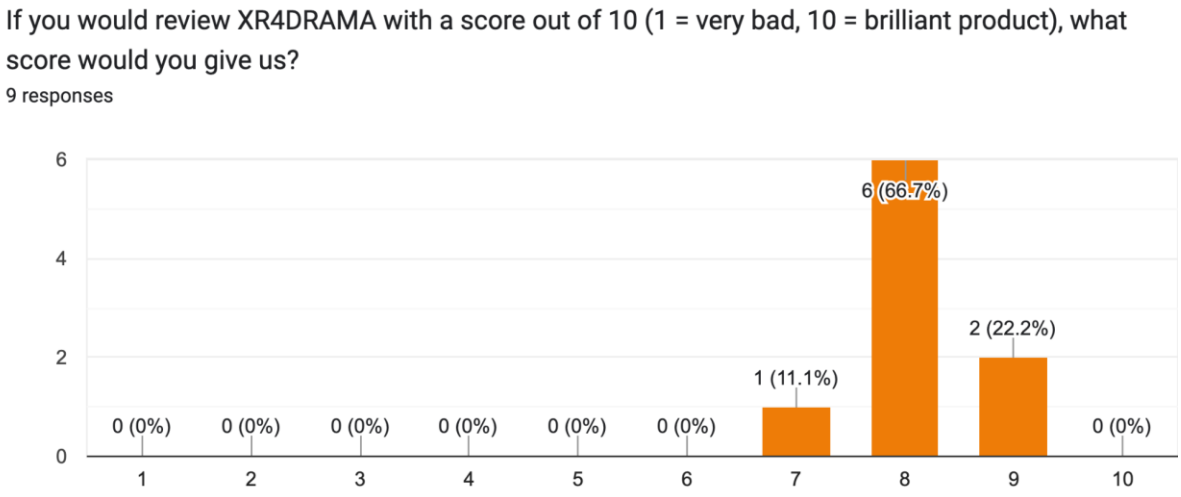
“The data is stored and presented with geo references. Using spatial computing (XR) for location scouting and production planning where the space matters is very innovative.”

“It cleverly uses the benefits of XR to make production planning much easier.”

Question 10



Question 11



Question 12

Any final thoughts or comments?

Answers:

“It would be great to see this product being available on the market.”

“It was totally impressive how fluidly the individual components already meshed. And I think that so far, we have only seen part of what would be possible with this tool.”

“I'd love to see a more polished version of the app and interfaces.”

“xR4DRAMA could be really useful once it gets to TRL 9 or 10, i.e.: once it becomes a fully-fledged product.”

“The range of functions is impressive, but the Authoring Tool is a bit difficult to use as the UI is quite confusing.”

“I really like the design of the mobile app.”

Question 13

What is your tagline/quote for xR4DRAMA?

Answers:

“xR4DRAMA would make my life as a producer in the field much easier. For all kinds of productions. All the information I need is available in one place.”

“I would love to see what would be possible with xR4DRAMA in the future.”

“xR4DRAMA could take location scouting and fixing for film productions to a whole new professional level and save producers time and money and avoid negative surprises on the ground.”

“The better your awareness, the better your choices.”

“We humans are spatial beings and perceive our surroundings in three dimensions. Therefore, it only makes sense to use the spatial and innovative technology XR for spatial topics where the situation on site matters.”