PANTHEON

Community-Based Smart City Digital Twin Platform for Optimized DRM operations and Enhanced Community Disaster Resilience

D8.2

REPORT OF PILOTS' OPERATION SCENARIOS

The project has received funding from the European Union's Horizon Europe programme under Grant Agreement N°101074008.

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TASK ABSTRACT

The operation scenarios are the base reference for the development of the PANTHEON system. They define both the conditions of use (dimensioning scenarios, rules of engagement, etc.) and the system specifications as defined by the community end-users. The task will issue a first approach at M14 (D8.1) to enable a quick start of the development phase. It will elaborate a second version (D8.2) of the report after the first training and exercises in Athens, based on the assessment and recommendations from the end-users.

This document is the second version of above-mentioned D8.1. It incorporates the full scenario descriptions as prepared for implementation and an overview of the contextual framework the pilots are technically embedded in.

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REVIEW HISTORY

Version	Date	Modifications	Editor(s)
0.1	10th November 2024	First draft	Benjamin Schuster
0.2	19th of May 2025	Elaboration of the Vienna scenarios	Benjamin Schuster
0.3	14th of July 2025	Inclusion of all four scenarios	Benjamin Schuster
1.0	4th of August 2025	Restructuring and addition of D3.6 use-case steps	Benjamin Schuster
1.1	14th of August 2025	Final internal overhaul	Daniela Weismeier-Sammer, Benjamin Schuster
2.0	10th of September 2025	KPI Appendix overhaul and inclusion of all external comments	Benjamin Schuster, Mike Karamousadakis, Christina Barrado

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EXECUTIVE SUMMARY

The PANTHEON project has developed four scenarios to showcase different combinations of the platform's components in training and planning deployments for different crisis situations. Scenario creation and platform component selection was done by a methodological framework consisting of a qualitative risk assessment weighing hazard likelihood against impact. Input was collected through interviews with experts, stakeholders and community representatives, and augmented by online surveys filled out by members of a similar group. The scenarios described here are the ones with the highest combined likelihood and impact and were chosen to be implemented by local end-users with extensive operational experience. As this deliverable is the second version and supplement of the previous D8.1, it will focus on the scenario descriptions themselves.

Two natural disasters, an earthquake scenario for planning and a wildfire scenario for training have been selected for Athens. For Vienna a heatwaves scenario has been selected for planning and a cyber-physical attack as man-made one and used for training.

The selection process for the scenarios has been documented in D3.6 and referenced in D8.1, which was the interim report to be concluded by this one. This deliverable focuses on the description of the final scenarios as pilot use-cases after the extensive adaptation process of scenario and technology to align with each other. The execution plans for the pilot deployment can be found in D8.3 and D8.4 respectively for Athens and Vienna in the form of playbooks. The report on the execution will be laid out in D8.5 and the evaluation of the pilots can be found in D8.6. The sections regarding the second pilot phase in D8.3 and D8.4 are subject to another update in the weeks prior to the actual pilots and will contain the final alignments as required by the technical development of the platform. Detailed interaction scripts with the platform will be created in the final weeks before the pilots.

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INTRODUCTION

This deliverable describes the completed scenarios that will be used by first responders to aid resilience building with Smart City Digital Twins (SCDTs) towards natural and man-made issues. The scenarios focus on the disaster relief cycle's preparedness and response aspects with an added emphasis on resilience building through advanced emergency relief force deployment planning and communication training. Aided by the PANTHEON digital twin platform, the described novel approach to relief force-training trades theoretical presentations for realistic digital simulations developed together with practitioners.

The developed scenarios aim to enhance disaster resilience efforts by implementing evidence-based tools for first responder deployment-planning and emergency personnel-training allowing repetition and skill-building. PANTHEON created a community-based and first responder end-user driven digital framework as a supplement to established tools and its deployment roadmap outlines phasing it into the end-user's routine initially as a complement to their workflow. Emerging innovations such as earth observation sensing and drone technology, as well as advanced simulation capabilities have all been considered to be incorporated in a meaningful way during scenario creation enabling showcasing those diverse modules. The strength of the platform stems from its ability to incorporate a combination of the components developed in the course of the project itself as well as components and data from other national [1] and international projects [2].

1.1 SCENARIO TYPE ADAPTATION AND IMPLEMENTATION

Two general application types for SCDTs in first responder organizations have been chosen early in the platform's development phase to supplement gaps identified at the organizations' regular operations. One variant is the platform's usage during planning scenarios that has been adapted to presenting all available data to operators and allowing for parameter adjustment. It has a focus on testing out the feasibility of existing standard operating procedures in a crisis situation, incorporating decision support and resource dashboard components. The second application is implemented as an augmentation of first responder training and is tailored to fit into current disaster relief force education curricula. The latter use-case includes a broader overview of digital twin simulation components, made available by PANTHEON throughout all potential additional applications, thus encouraging creative usage of the platform by the trainers to allow for deployment-simulations not originally foreseen during development. This is achieved by components that are not specifically tailored to a certain use-case which are optionally available in the user interface presented as selectable supplementary information layers to the users.

All components were evaluated regarding system access, information integrity and compliance of the SCDT and AI systems to the project's data protection impact assessment and general GDPR-based risk assessment. An extensive list of KPIs has been developed during the scenario adaptation process to allow for implementation-evaluation after the two pilots. The list of KPIs can be found in this document's appendix.

Practical implementation of the scenarios is highly dependent on the technological development of PANTHEON's core components. Changes in scenario flow, participant training, evaluation and platform presentation all consider this and have been implemented to allow for the execution of the scenario regardless of technical impediments through incorporation of pre-generated fallbacks for the interaction with the platform. To guarantee a robust scenario implementation a "guided table-top exercise"-approach, with a scripted scenario flow and system interactions aided by a consortium member, has thus been selected for the project's piloting phase.

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The scenario flows for all pilots will be taken as references from this deliverable and can be found again in a condensed form in the deliverables D8.3 and D8.4 for the implementation of the pilots as a component of the exercise guidance methodology (XGM).

1.2 USE-CASE DESCRIPTION AND ELABORATION AS DERIVED FROM D3.6

The scenarios in this deliverable contain as a reference all steps described in chapter 4 of D3.6's use-case descriptions and elaborate all functional steps that depict the flow of operations a user will follow during the pilots. The interactions from D3.6 have been added to all pilot scenarios at all scenario descriptions to be found at the x.x.1.2 First responders' engagement subchapters for Athens and Vienna respectively. In addition to all the steps described during the first responder's engagement at the respective scenarios, all use cases contain following features of the PANTHEON platform:

- User authentication for specialised personnel roles
- Securing the platform after user logout
- User account management by authorised personnel

This was a technical requirement implemented as to enable privileged users to access restricted data. During the pilots, the scenarios will not contain any restricted data from first responder organisations, so interaction with this feature will be demonstrated only.

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PILOT SCENARIOS

1.3 ATHENS

In September 2025 the first pilot deployments of the PANTHEON platform will take place in the form of guided table-top exercises at the premises of the Hellenic Police in Athens/Greece and will be implemented by KEMEA.

1.3.1 ATHENS 1 – PLANNING (EARTHQUAKE)

Athens first pilot scenario will be the simulation of the response of law enforcement to an earthquake in the Athens metropolitan area.

In an event like this, the police as a law-enforcement agency acts as part of the civil protection mechanism and therefore has to mobilize all available resources and assets to ensure safe and timely evacuation of buildings and/or other areas of interest. Furthermore, police forces have to respond to emergency calls (for example by elderly people stranded after the earthquake, drivers stranded due to roads blocked by debris etc.). For this scenario, from an operational perspective, the goal is to develop a plan that will ensure the effective and accurate deployment of all available resources (vehicles and other mobile units) so that all assets are strategically located throughout the metropolitan area to minimize response times.

The PANTHEON system will be utilized as a simulation tool to assist the Athens police-staff prepare for mobilization and deployment of available resources after an earthquake.

1.3.1.1 Scenario flow

A Hellenic Police staff member will guide through the pilot and act as trainer for a group of active practitioners who would in real life also perform the duties foreseen for them during the pilot. The scenario focuses on a single event (earthquake) and covers one day of operational planning. Players to be included in the scenario are members of the Athens police (traffic police, emergency call response units, special units etc.).

The detailed planning scenario-flow was elaborated as follows:

I. On September 9th, a strong earthquake occurs at 3 a.m. within the region of Attica, a few kilometers northwest of Athens. The earthquake is caused by an active fault at the southwest slopes of the Parnitha mountain. The coordinates of the epicenter are 38.08 N (north) and 23.60 E (east), the magnitude is 6.3 on Richter-scale and the focal depth of the earthquake is 9.5 km.

II. The earthquake is strong and shallow. These types of earthquakes lead to intense ground shaking, as they release more energy near the surface. This leads to severe damage and generates unexpected secondary events of strong impact (i.e. cascading effects).

A. Landslides are observed and lead to the blocking of the road that leads to the military base at the peak of the Parnitha mountain.

B. Ground deformations are observed mainly in the western parts of the Region and lead to damage on railway infrastructure.

C. Several critical infrastructures are affected by the seismic event including the energy sector, natural gas stations and pipelines are damaged, the transportation sector with the railway being

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severely affected, telecommunications disruptions and power shortages throughout the city of Athens.

III. Reports regarding collapsed and heavily damaged buildings are received by the 112-emergency call center, which then distributes the relevant information to all engaged first responders' organizations.

After the scenario, participants will go through a debrief to finalise the session.

1.3.1.2 First responders' engagement:

As outlined in D3.6 in UC-DS-ATH-A the first responders' engagement is planned as follows:

1. User sets up earthquake simulation: By law, the Hellenic fire service is responsible for search and rescue operations. Due to the occurrence of the earthquake very early in the morning there is an increased probability for a large number of casualties as well as entrapments beneath the debris. The intensity of the earthquake will be preset in this step.
2. User enters organizational assets: The national center for emergency assistance is mobilized for triage and medical evacuation, and to treat injured casualties. Their assets, including drones, will be represented in the system.
3. User initiates simulation
4. System runs cascading effects simulation
5. Stakeholders receive simulation insights and decision support: The Hellenic police assist in evacuation procedures and regulate traffic as a reaction to the simulation. Decision support is provided e.g. by UAV situational pictures.

As mentioned above, in the context of PANTHEON, the first responders engaged in this scenario will be Police officers.

After the start of the scenario (occurrence of the earthquake), the planned interaction of users with the PANTHEON system can be described as follows:

- The user can see in the PANTHEON digital twin interface what types of infrastructure are located in the vicinity of the earthquake epicenter and affected infrastructure is displayed on the system interface for decision support (helping decide which resources will be deployed where).
- Depending on the call for service, the user prioritizes the deployment of resources and decides which vehicles/units will be deployed to which area. This decision will be based on the best available routes by considering blocked roads.
- The routes are displayed on the system interface highlighted and the end-user has the option to change routes in a dynamic way based on the feedback they will be receiving from unmanned aerial vehicles (UAVs). UAVs will be instantly deployed over the disaster area and will be transmitting pictures and co-ordinates. The feedback about unusable routes will be sent to the user interface and the decision support system. This information will then be used by the system operator to decide on the deployment of resources.
- All available routes and paths that can potentially be used by first responders are also depicted in the system interface prioritizing the best possible response time.
- The system displays all deployed resources on the map using distinct symbols.

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- The system factors-in traffic conditions along with road blockages (if any) due to collapsed buildings so that the feedback received by the system operator is accurate and allows them to make an informed decision.

1.3.1.3 PANTHEON system interface information categories:

The following information should be displayed in the system interface as available categories:

- Affected areas / areas that have sustained significant damage by the earthquake are highlighted
- Population density as color overlay
- Critical infrastructure that has been affected or severely damaged. Only damage positions provided by the earthquake simulation and included in the scanned area will be returned.
- Other points of interest, such as schools or nursery homes and areas where vulnerable groups and/or people in need are located
- Deployment and evacuation routes
- Response time prediction based on the route chosen
- Location of Police Stations, vehicles and other mobile units
- Location of UAVs: only the final position of the UAVs will be provided after mission end (that can be the same as the initial position) as the flight will not be shown.
- Location of telecommunications towers
- Location of parks and open spaces as potential assembly points for evacuation

1.3.1.4 System interface in detail:

Most of the PANTHEON system's end-users face complex decisions in complex environments during their day-to-day operations and therefore have the urgent need for a non-convoluted system to navigate. That is why the planned design of the PANTHEON user interface must be user-friendly and allow for a smooth and rapid response to different incidents. In a nutshell, a user-friendly interface will allow officers to quickly switch between sources displayed on the screen.

Main components of the system interface ideally display a layered GIS interface and should provide end-users with an explicit understanding of its different information layers. Ideally, the interface can be configured to only display the information that currently matters, based on the needs of the user. This information to be displayed based on pre-defined settings is including, but not limited to: ambulances, fire trucks, private security, police patrol vehicles, emergency response teams (ERTs), drones, critical infrastructure, schools, government buildings, police stations, city halls, gas stations, shopping malls, supermarkets, cinemas/theaters, stadiums, indoor arenas, etc. Furthermore, other incidents of interest may be displayed to assist the end user to make the best possible decision with regard to how their resources will be deployed.

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1.3.2 ATHENS 2 – TRAINING (WILDFIRE)

Athen's second pilot scenario will incorporate a wildfire occurring near the suburb of Fyli, in northwest Athens metropolitan area.

The use of the PANTHEON system as a training and exercise tool in the wildfire scenario will follow a 3-step approach:

- A realistic scenario about a wildfire will be presented to the trainees, mainly consisting of law enforcement staff
- The interactions with the system and the responses to the PANTHEON platform from law enforcement participants will be collected
- The scenario will incorporate the trainees' input, thus presenting them with tangible results of their actions

This approach is in line with the HPOL's use of hands-on exercises to train officers and first responders.

As part of the civil protection mechanism, the role of the police as law-enforcement agency will be to mobilize all available resources and assets to ensure timely and secure evacuation of buildings and/or other areas of interest, including residential areas, as well as responding to emergency calls (for example by elderly people stranded in remote areas or drivers stranded due to a road closure due to the wildfire rapid spread etc.)

From an operational perspective, the training goal is to provide law enforcement officers will the opportunity to have hands-on experience and test their operational response and the effective and accurate deployment of the available resources - namely, vehicles and other mobile units - so that all resources are strategically located throughout the metropolitan area as to minimize the response time. Also, the training scenario will become a platform to reconsider/redesign existing plans and response strategies.

The PANTHEON platform will be utilized as a simulation tool to assist the Athens Police staff to prepare for mobilization and deployment of available resources during a wildfire event.

1.3.2.1 Scenario flow:

The scenario will pertain to a single event (wildfire) and will cover one day of events.

A wildfire in the area around the northwestern suburbs of Athens is the scenario's trigger event. Specifically, during the afternoon hours of the 16th of September 2025, the pilot date, a forest fire breaks out in the proximity of the Fyli town. Although the fire does not burn densely forested areas, due to strong winds, it threatens nearby critical infrastructure and endangers the population.

Potential players to be included in the scenario: Athens Police staff – traffic police, 911 response units etc.

The detailed flow of the training scenario is as follows:

a) The first indication of a wildfire is reported by witnesses to the emergency call center. The information is then dispatched by the National Coordination Centre of the General Secretariat for Civil Protection to all relevant stakeholders who engage in response operations.

b) The wildfire is affecting a sparsely forested area at a hillside, which is mainly vegetated with bushes and low vegetation in general. Nearby lies the town of Fyli, which is not directly threatened by the fire. Although this area is not densely populated, as it lies outside of the Athens metropolitan area, it contains many industrial sites and critical infrastructure that can be severely affected by the fire.

Potential damages/ cascading effects to be considered by the end users include:

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- Transportation hubs: The fire, driven by the very strong winds, reaches the Attiki Odos highway and the railway, causing serious damage to the infrastructure, ultimately leading to a curfew.
- Energy Grid Failure: The nearby natural gas installation is severely damaged by the fire with explosions being documented in the gas pipelines. Nearby towns suffer from gas shortages.
- Pollution from the Ano Liosia dumping ground: The fire reaches the nearby Ano Liosia dumping ground, an area which concentrates vast amounts of waste from the metropolitan area of Athens. A large plume of toxic smoke is created and heads towards the town of Aspropyrgos and the island of Salamina.
- Water and power supply: Both the water and power network of the surrounding area are damaged, and their function is suspended.

1.3.2.2 First responders' engagement:

Alignment with the UC-DS-ATH-B D3.6 use-cases and elaboration:

I. User sets up wildfire training simulation: The main agency responsible for the management of wildfires in Greece is the Hellenic fire service, which undertakes fire-fighting operations. The simulation output will initially be tailored to their specifications and features a fire propagation model.

II. User inputs organization's assets: In addition to the fire service, the Hellenic Police take curfew measures in order to facilitate the incoming flow of fire-fighting vehicles, while concurrently assisting in the evacuation of the affected population should the need arise. The assets depicted during the scenario will be the Hellenic Police's.

III. User initiates simulation: for the purposes of the training scenario, the PANTHEON system can guide first responders to allocate resources strategically, not just based on proximity but also on the potential cascading effects that could be mitigated by safeguarding specific infrastructure or the points of interest and consider their deployment routes.

IV. System runs cascading effects simulation

V. Analysis of simulation outcomes: Ideally, for training purposes the system provides the end-users with information that allows them to make an informed decision and thus act as a decision support system.

In the context of PANTHEON, the first responders engaged to interact with the platform will be police officers.

Upon receiving the information regarding the wildfire, the system user will have an available interface that will provide them with the following information:

a) The system displays the different types of critical infrastructures that are located in the vicinity of the forest fire area; moreover, the system will also display any affected infrastructure as the fire progresses. This is especially important from a training standpoint as it will allow the system user to make an informed decision regarding possible redeployment of resources on the ground.

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b) As a wildfire is more of a dynamic rather than a static event, the interface may have an "update" feature available on the main menu that will either update the system in regular intervals (for example, every other minute) or allow the users to do so manually at their own discretion.

c) Ideally, the system user can sort all available info to prioritize which buildings, areas or infrastructure need immediate attention and, subsequently, is able to deploy their resources as they wish.

d) A critical feature of the PANTHEON system is the "best available route". As any fire is a dynamic and complex event the "best available route" may refer to two separate situations", namely:

   I. best available route to evacuate stranded citizens or engage in a preemptive evacuation.

   II. best available route to allow for a rapid deployment of available assets in the affected infrastructure. For example, a natural gas pipeline explodes, thus posing a major threat for the safety of people who may approach the area. The first responders should have the option to approach the area ASAP and secure the scene ensuring that no unauthorized individual approaches and no citizens are exposed to any life-threatening situations.

   Both available and unavailable routes can be displayed on the system interface. Depending on the feedback received from the drones, the system user will be offered a number of options to change the evacuation and deployment routes, if necessary, in a dynamic way.

   The system user will be able to utilize pictures and coordinates received by the drones regarding the disaster area. This data can then be used by the system operator to decide on the deployment of resources.

   All available routes, paths and available assembly points that could be potentially used by first responders may also be depicted in the system interface prioritizing the best possible response time.

e) The system will display all available first responders' resources, POIs and major critical infrastructure on the map using distinct symbols

f) The system operators may have the option to submit queries to the system that will help them identify the best course of action. For example, during a potential evacuation the end-user submits the following query "what is the best available route to evacuate 100 people from point X to the assembly point Y?"

g) The system will factor in traffic conditions along with road blockages (if any) because of the fire expansion so that the feedback received by the system operator is accurate and allows them to make an informed decision.

1.3.2.3 PANTHEON system interface information categories:

The following info will be displayed in the system interface as available categories in the system menu

- Affected area / areas that have sustained direct significant damage by the wildfire
- Areas that are expected to be affected by the wildfire in case it expands.
- Population density in different colors

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- Critical infrastructures that have been affected/ severely damaged from the wildfire, either directly or indirectly.
- Critical infrastructures that remain unaffected.
- Other points of interest, such as schools, nursery homes and areas where vulnerable groups and/or people in need are located and should be evacuated, if needed.
- Deployment and evacuation routes
- Response time prediction based on the route
- Location of police stations, vehicles and other mobile units
- Location of UAVs in the proximity of the affected area and other subareas of interest.
- UAVs missions/routes in case multiple areas are affected.
- Location of energy grids/ dumping grounds
- Location of Telecommunication towers as well as Police radio towers.
- Location of parks and open spaces that either have been already designated as assembly points or could be potentially used as such during evacuation.

1.4 VIENNA

The scenarios for Vienna are presented here in a fashion that might need to be amended with necessary adaptations arising from the final technical implementation and maturation of the platform after the first pilot in Athens. Updates to the scenario flow will incorporate the learnings from the first pilot and reflect the technical realities as required.

Both of the scenarios in Vienna are localized in the same coordinate grid in the northern part of the city (Figure 1):

48.268401,	16.400358
48.280664,	16.400358
48.280664,	16.432987
48.268401, 16.432987	

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Figure 1- Vienna scenario area –on the left marked in red to the north and zoomed in satellite image right

The scenario area has been chosen after carefully considering the requirements of both Vienna scenarios, aligning typical medical first-responder tasks with PANTHEON's simulation capabilities. Within the scenario boundaries, some of Vienna's most densely populated and extensively sealed off areas on the one hand, as well as sparsely populated allotment clubs with ample green spaces on the other hand, are included. The area provides narrow and therefore easily blocked roads as well as major connecting roads. Due to its relative proximity to the Johanniter's main headquarters in Vienna, which is also the drone squadron's main base of operations, this is a realistic part of the city the Johanniter would be tasked to survey in case of an incident. To the southwest a major hospital is situated.

1.4.1 VIENNA 1 – PLANNING (HEATWAVE)

Vienna's first guided tabletop exercise scenario (use case 1) will be a simulation of a typical medical first responder planning task, which is the structured establishment of temporary outpatient care centers, referred to as ambulances. Establishment of temporary ambulances, especially during large scale events, is a typical task for the Johanniter and simulation tools have been frequently requested to aid location selection by planners. In this scenario, the ambulances will be "cooling spots" to provide local relief and immediate care to people affected by a summer heatwave. Vienna as a city has been affected by global warming to an extraordinary extent in recent years, as the average temperature has risen even more than the global average and the last years have all respectively been the hottest ever recorded[1]. Vienna's infrastructure is well prepared for cold winters but constant high temperatures during summertime have not been a usual occurrence. Hence, there are many people, especially those belonging to vulnerable groups, considerably affected by the heat who are ill-prepared regarding coping with heat-related challenges.

1.4.1.1 Scenario flow:

The initial trigger for the use case is the commissioning of Johanniter by the Viennese municipality to establish cooling spots (Figure 2) in distinct parts of the city during an extensive heatwave. Johanniter's planners will be tasked to develop a plan to implement said cooling spots in an economical and practical fashion and

[1]Orlik A., Rohrböck A., Müller P., Tilg A.-M. (2025): Klimarückblick Wien 2024, Wien https://ccca.ac.at/fileadmin/00_DokumenteHauptmenue/02_Klimawissen/Klimastatusbericht/KSB_2024/KRB_2024/Klimarueckblick_Wien_2024.pdf

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coordinate the resource usage with the locally available personnel and material resources. The PANTHEON system will be used as a simulation tool to help Johanniter staff prepare such a deployment, by suggesting placement according to several parameters, including heat hotspots, space and proximity to vulnerable groups. The system will support deployment decisions with resource usage projections (i.e. human and material resources needed to establish cooling spots) and will assist planners in creating multiple deployment plans with varying degrees of coverage and associated manpower and material costs. The platform will explicitly be presented as an additional tool and its usefulness in augmenting the planner's everyday tasks will be evaluated.

Figure 2 - Illustration of a cooling spot

This will be a half-day scenario with end-users being first introduced to the scenario conditions and then shown the platform's abilities and its usage as a planning support tool. As the pilot is intended to be implemented in the form of a guided table-top exercise, interactions with the system itself will be supported by a consortium member.

Players to be included in the scenario are members of Johanniter's chief inspectorate, logistics management, operations center, shift planning and the disaster relief team. This cross section contains experts with extensive knowledge in planning deployments of all dimensions in the field and managing the resources needed for keeping forces in effective action for extended periods of time. Establishing outpatient care centers in the form of ambulances is a routine task for all participants. The simulations of heatwaves provided by PANTHEON are a novel addition to tools already in use and the scenario represents a comprehensible depiction of operational realities that are already coming up.

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1.4.1.2 First responders' engagement:

Alignment with UC-DS-VIE-A D3.6 use-cases and elaboration:

I. User sets up heatwave simulation: The PATHEON platform will initially be used to simulate and graphically show the effects of heatwaves on the city of Vienna as a map overlay. The main focus will be on a visualization of heatwave effects as derived from solar radiation.
II. User inputs organization's assets: In the user interface, spots that fit certain criteria will be selectable during the heatwave and the combination of hotspots and available resources will aid users in placing ambulances, i.e. cooling spots. Depending on the heatwave's effects on the scenario location, planners will be able to gauge resources needed to establish meaningful coverage of affected areas over the duration of the heatwave.
III. User initiates simulation

The main information categories for participants regarding decision support during planning deployments are results of the simulation in the map (with possibility to edit output). The ability to enable/disable spots, in a resource dashboard and estimate resource demand, display resource usage according to duration, propose number of needed spots will be used to gauge viability of different deployment scenarios.

Users will adjust resources needed per spot and calculate total manpower and material required. The main advantage of using a planning tool like PANTHEON will be to aid planning for a change during deployment according to the projected effects of the heatwave and establish the needed capacities at the right locations for the ideal duration.

1.4.1.3 PANTHEON system interface information categories:

- Hotspot area (high temperature, no shadow, high solar radiation etc.; heat vulnerability defined as an area matching a set of parameters)
- Heatwave duration (use weather forecast and compare it to a period of time we already have data for)
- High population density / vulnerable groups (create focus areas with heightened need to have a cooling spot nearby)
- Available space (reachability)
- No cooling spot already present (exclude areas that already have spots initiated by the city)
- Prediction of probable deployment time/duration (derived from weather forecast compared to historic data)

1.4.2 VIENNA 2 – TRAINING (CYBER-PHYSICAL ATTACK)

This will be the final pilot scenario of the piloting phase of PANTHEON and thus should ideally showcase most components developed throughout the project. For the training scenario (use case 2), a man-made disaster in the form of a cyber-physical attack has been chosen through evaluation of probability against impact of such an event. The scenario type is a typical example for high-impact novel threats with little preparedness to date. Regarding the implementation of the scenario, a regular staff-exercise, focusing on the tactical (silver) level in the command chain, will be executed with small PANTHEON specific adjustments.

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1.4.2.1 scenario process flow

In this scenario, the backup power supply systems (UPS) present at communications towers in the city are manipulated into dramatically overheating and exploding by an unknown, potentially terroristic, actor. For simulation purposes, an average 800 Ah battery is presumed to be present at all tower locations. The scenario-flow will have three distinct phases with cuts in-between. In the scenario timeline, after each phase a time jump is made, thus presenting different issues the trainees will have to react to without expanding the training time too much.

The exercise tasks will focus on the management of force deployment as typically trained in the course of platoon commander qualification curricula by the disaster relief forces. The trainer will have a central role in this scenario and will act as the command center for the trainees. Situational overview information from the PANTHEON system will be presented to trainees as though it was gathered by drone flyovers. Incidents happening at sites not surveyed by drones will be simulated inside the system and shown to the trainer but not displayed to the trainees unless they task a drone flyover. Further information in the form of instructions from the command center will complement the scenario. Force deployment inside the PANTHEON system will be done by the trainer as communicated by the trainees.

The three phases of use case 2 are:

- T0: The initial “chaos phase” starts with the first Johanniter elements being dispatched after multiple small-scale explosions and fires have been reported around the city. The cause of the explosions, damage and number of casualties is yet unknown. Drone swarms will provide initial situational overview including infrastructure damage, smoke dispersion and detection of casualties in outdoor areas.
- T1: Additional explosions cause further casualties and disruption of traffic. Trainees need to adapt to the changed situation and communicate with other first responder organizations. This phase is foreseen to incorporate the shift towards a structured deployment and a coordinated pulling-back from hot zones while larger scale evacuation is initiated.
- T2: In this phase, at the latest, continued explosions should lead to the conclusion to classify the incident as a tactical attack on Vienna’s infrastructure. Hence, participants need to reevaluate the initial placement of forces and collection points as well as reconsider force deployment and routing. Additionally, cooperation and coordination with other emergency services is needed.

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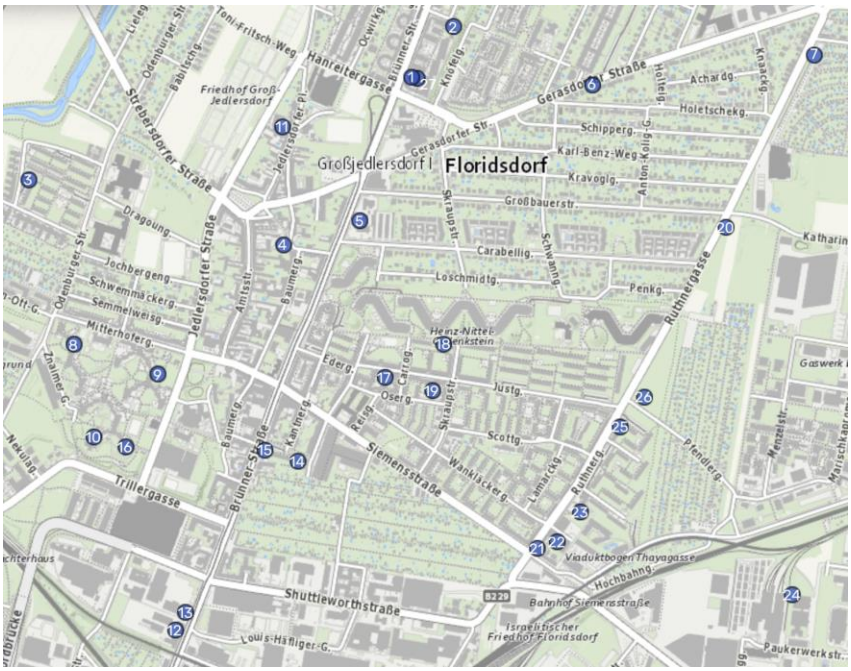

Figure 3- Communications towers in and around the scenario playing field. Graphics and tower location from senderkataster.at. Numbers overlayed

1.4.2.2 System interactions and information presentation interface

A Johanniter staff member will guide through the pilot and act as trainer for a group of active practitioners who would in real life also perform the duties foreseen for them during the pilot. The trainer will be responsible for presentation and preparation of the T0-T2 situational scenario overviews and prepare the three timeslots that are to be simulated. A member of the drone squadron will be tasked to deploy the drones-swarms over the affected area as instructed by the trainees to simulate the actual chain of command.

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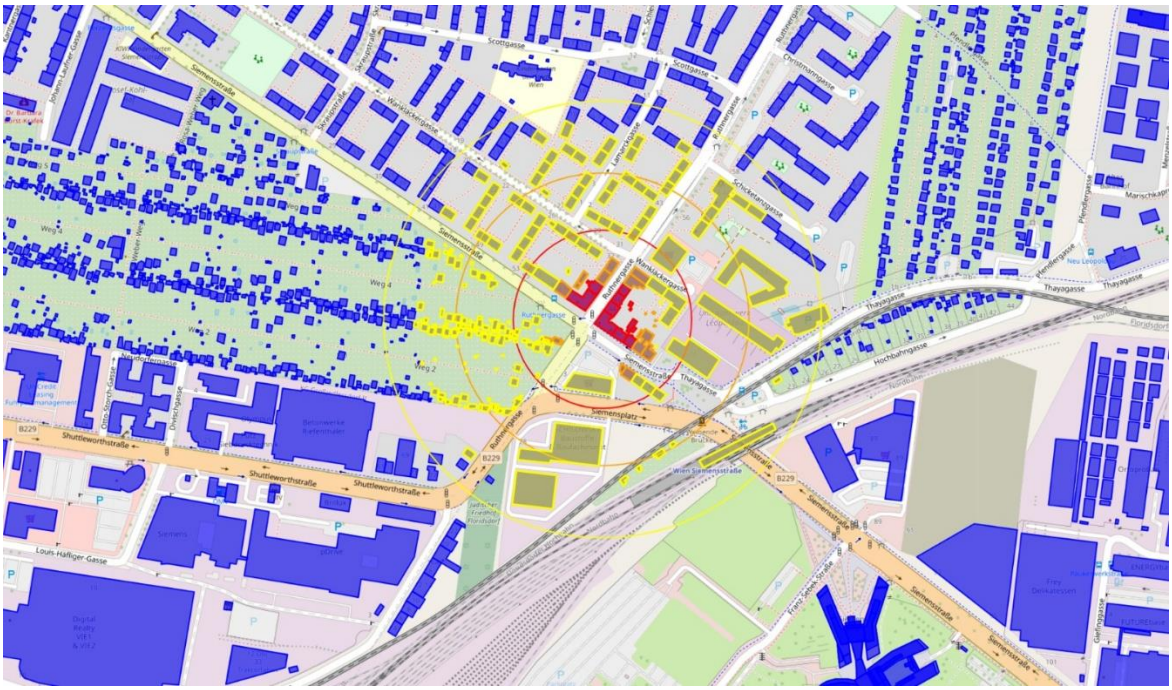

Figure 4- Cell tower explosion simulation

Simulation of traffic will be used to ensure optimal routing to the established triage, treatment and transportation areas as defined by the trainees.

The output of PANTHEON's simulations will be presented in full to the trainer and then be relayed to the trainees after they have tasked drone flyovers in the form of situational pictures. The role of drone-squadron commander will be played by an active member of the Johanniter drone squadron.

After the scenario, participants will go through a debrief to finalise the training session.

1.4.2.3 PANTHEON system information categories

Always:

- Force deployment as chosen by players
- Overlays with POIs

After drone fly-overs:

- Infrastructure damage
- Smoke plumes from fires
- Detected casualties on the map

Functionally available:

- Routing information considering blocked paths

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CONCLUSIONS

This deliverable is the updated main scenario reference point for implementing the pilots in alignment with the technical development of the platform over the course of the project. It contains the results of ongoing adjustment efforts on technical and end-user side to develop a platform tailored to end-users needs and showcases all the components produced by the project consortium.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
POI	Point Of Interest
UAV	Unmanned Aerial Vehicle
UPS	Uninterruptible Power Supply
TTX	Tabletop Exercise

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APPENDIX

Following is a compact KPI list excerpt taken from the central component list with short descriptions.

All must-have KPIs are included in this list. The full list is available at the project repository. These items will be used for validation after the pilots.

№	KPI
K1	Interface has time display of current simulated scenario time
K2	Interface has display of realtime elapsed since incident start
K3	Interface overlay: POI - cell phone towers
K4	Interface overlay: POI - established cooling spots
K5	Interface overlay: POI - evacuation spots
K6	Simulation capability for infrastructure damage
K7	Information about population impacted, time to evacuate and time for evacuation
K25	UAVs provide roads blocked by infrastructure damage
K26	UAVs provide environmental data and disaster impact as casualties after the simulation execution.
K27	UAVs provide detected damaged buildings (by earthquake and cyberattack) as 2D images after the simulation execution.
K33	Simulations covers pre-defined bounding box in Vienna and Fyli
K36	Simulation capability for explosion impact on local buildings and people
K37	Simulations outputs plume/smoke direction
K44	Serves delegated WMS Satellite, building and fuelmap layers from Copernicus
K48	Serves GeoTIFF fuelmap, population and community data layers
K52	Serves Infrastructure power, communication and building-related POIs
K55	Serves place POIs for schools, police, hospitals and fire-stations
K59	Serves Community and Vulnerable Population Data
K60	Serves nearest Roads functionality
K63	For any blocked intersection, alternative paths should be proposed
K64	All assembly points capacity is changed according to the disaster propagation
K65	Routing offers the best possible path to destination
K68	User can select different intensity parameters for the simulation.
K71	The user can define the area, the number and type of UAVs for deployment.
K73	The area to scan is split to UAVs and paths to be followed by each UAV aredisplayed.
K78	The user can place resources on the map and the system provides available routes to reach points of interest on the map.
K84	The usage of the system reduces paper-based planning reliance.

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