NEWSLETTER

ODYSSEUS H2020 PROJECT

Preventing, Countering, and Investigating Terrorist Attacks through Prognostic, Detection, and Forensic Mechanisms for Explosive Precursors

ODYSSEUS Newsletter No 2.

Dear readers,

We are excited to share with you the second ODYSSEUS newsletter!

The ODYSSEUS project is counting two years of activities and developments. Our newsletter aims to provide you with the latest information on the project's results, on recent events and achievements.

This edition promises to be very interesting as it focuses on the first field trials of the ODYSSEUS Project held in Bulgaria and Italy and allows you to enjoy a first glimpse of the full ODYSSEUS solution. A member of our consortium won the 2023 European Commission Security Innovation Award for their T4i DOVER®. Finally, ODYSSEUS organized the first joint workshop with project INHERIT.

Scroll down and find out more!

We hope you enjoy our latest newsletter and wish you all the best for the New Year 2024!

The ODYSSEUS team

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Main Topic: ODYSSEUS Consortium implements PUC1 in two iterations in Bulgaria and Italy

In June and November 2023, two iterations of PUC1 were conducted in the two test sites of Stara Zagora (Bulgaria) and Vicenza (Italy) focusing on a case scenario of Detecting HME factories based on the use of ODYSSEUS' prognostic, detection & forensic tools.

Consortium partners at PUC1.a in Stara Zagora (Photo: P. Vasilev)

Consortium partners at PUC1.b in Vicenza (Photo: P. Vasilev)

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PUC1.a in Stara Zagora

During PUC1.a at Stara Zagora, the focus was directed on the OSINT investigation components of ODYSSEUS, aiming to identify HME recipes, analyse social networks in which the recipes are shared, monitor chemical supply chains and detect suspicious market transactions. The PUC also provided the opportunity to conduct first tests with the UAV and UGV platforms that carry the water and air sample sensors and to test the vapour sensor.

In the implementation of the use case scenario workflow, the first ODYSSEUS tool, introduced to the participants was the first version of the ODYSSEUS **Dashboard**.

The ODYSSEUS Dashboard is the entry point to the ODYSSEUS integrated platform for end users, providing a Graphical User Interface (GUI). The Dashboard provides views and visualisation elements for the ODYSSEUS components, combining and presenting their data to the users in a coherent way.

The ODYSSEUS Dashboard is the front-end of the ODYSSEUS integrated platform and as such, it combines the application logic from all backend components to form a meaningful and user-friendly flow for the user to follow. It does not generate any data; instead, it is serves as the presentation layer for the visualisation of data produced by other components.

The main functionality offered through this version of the Dashboard was the following:

1. Web data collection, data upload functionality, alert mechanism
2. Transactions page with transaction data collection
3. Text translation and analysis page
4. Visual analysis page
5. Social Network page

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6. Drones page
7. Field Operation page
8. Admin page

The initial versions of the Dashboard did not offer full functionality to the users; full functionality is expected in the upcoming final version, which is already underway, when the backend components are also finalised, and the end users have provided their feedback on aspects that can be improved towards a better user experience. The plan for the final version of the Dashboard is to adopt a more operation (mission)-based approach where the functionality of the components is combined to offer to the end users a holistic view of the system.

The screenshots below depict a part of the functionality offered by the ODYSSEUS Integrated Platform through the current version of the Dashboard.

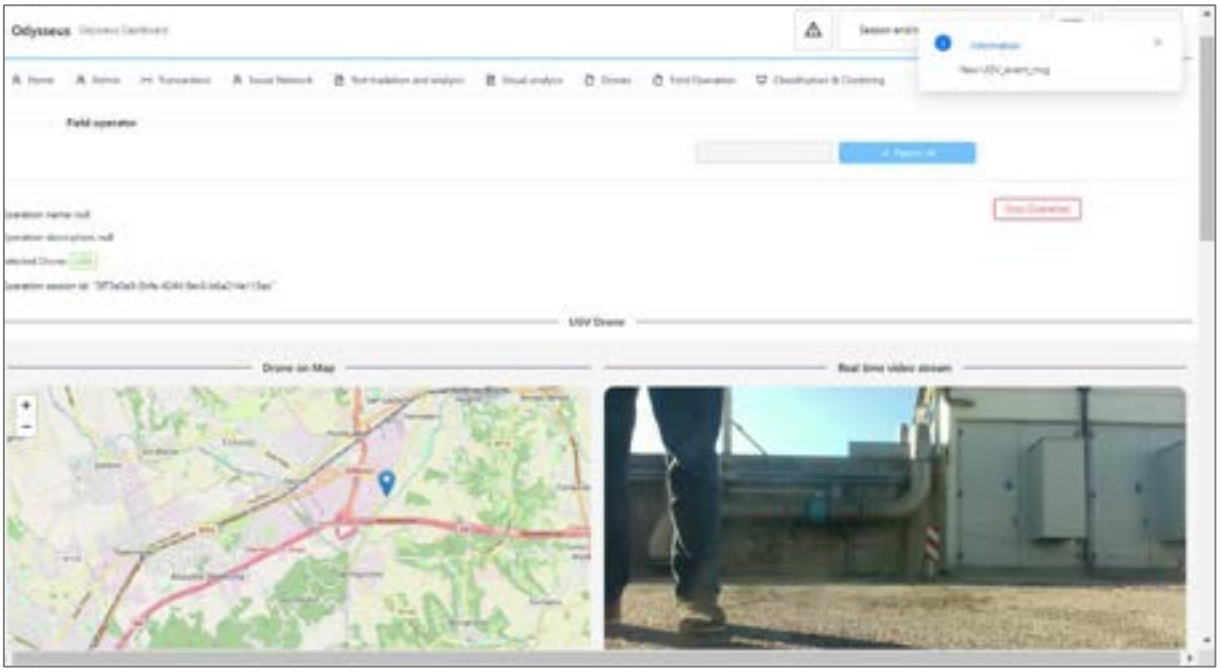

Figure 1: ODYSSEUS Dashboard – Field operation page

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Secondly, ODYSSEUS capabilities in collecting and analysing online HMEs recipes were demonstrated, showing the crawling and content acquisition functionalities using search keywords related to explosive precursors:

The **Text Analysis** (TAN) component is responsible for analysing the multilingual textual content of online resources and extracting HME-related entities. The initial version of TAN was demonstrated and tested in terms of identifying a number of HME-related entities on data gathered from the Surface Web.

The **Machine Translation** (MT) component is responsible for the automatic translation of multilingual textual content. MT is a complimentary technology enabling the multilingual analysis for textual models operating in English. The initial version of MT was demonstrated and tested on data gathered from the Surface Web supporting translation from Arabic to English.

The **Visual Understanding** (VU) component is responsible for analysing images gathered from online resources and detecting HME-related objects/concepts. The initial version of VU was demonstrated and tested on data gathered from the Surface Web identifying a number of HME-related objects/concepts.

The **Multimodal Analysis** (MA) framework consists of three components, namely, the *classification*, *clustering*, and *social network analysis* components.

The **Classification** component is responsible for the categorisation of textual data in terms of whether they are related to HME recipes (or not). The **Clustering** component is accountable

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for grouping together multimodal documents from online sources based on the topic discussed. The **Social Network Analysis** component is responsible for analysing social networks formed by users participating in a social media platform and/or a Web forum and detecting communities of users as well as identifying their key actors. The initial version of the MA framework was demonstrated and tested on data gathered from the Surface Web in terms of (i) their classification based on whether they contain HME recipes, (ii) their clustering based on the topics discussed, and (iii) the user communities detected within a synthetic Web forum together with their most influential actors.

The **Threat Assessment** (TAS) component is responsible for assessing the HME-related threat level by leveraging measurements from sensors detecting chemicals in the air and/or water. The initial version of TAS was demonstrated and tested leveraging data from the ODYSSEUS air sensor.

Thirdly, the ODYSSEUS **Suspicious Transaction Module** (STD) was introduced and tested. This module dynamically monitors incoming transactions made on the chemicals supply chain and attempts to predict whether a transaction should be flagged as suspicious or not by exploiting a-priori knowledge about HME recipes and precursors. It also implements and facilitates the application of Regulation (EU) 2019/1148 about HME precursors. The STD enables transaction search in constrained geographical areas and temporal intervals for assisting end-users in fine-grained investigation regarding illicit HME precursor acquisition.

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hash:
22b2519ef3e336aea367ce2303b5f41cfd295a2b239936c01f543fb7461cb4ee
id:
22b2519ef3e336aea367ce2303b5f41cfd295a2b239936c01f543fb7461cb4ee
buyer: 10
seller: 5
item_description: Ammonium Nitrate
amount: 10
unitofmeasure:
country: Bulgaria
timedate: 2019-03-19 21:54:52
buyerlicence: 10
latitude: 42.425843
longitude: 25.643487
suspicious: 1
previous:
477bc4c62585e78746be1d726aa896276b7bfd765ab5656ad25be01202b3041e
report: https://std-api.odysseus-online.rid-intrasoft.eu/std/report/user/10

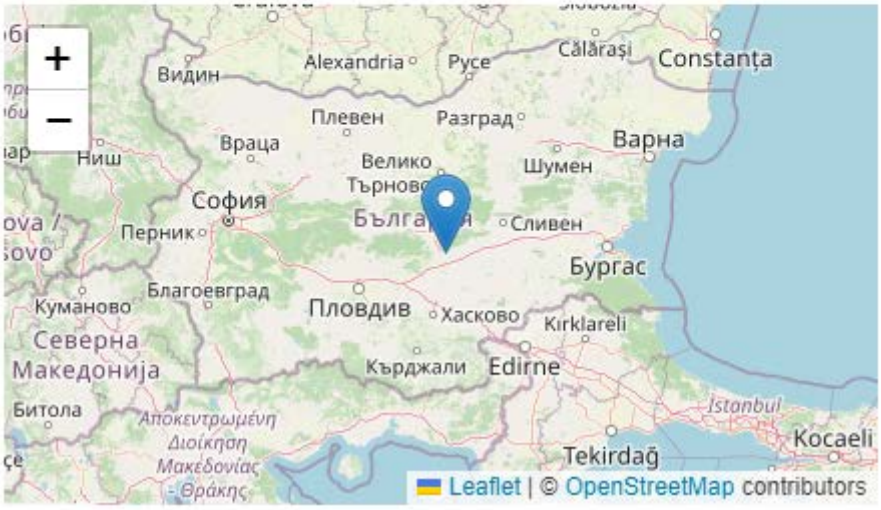

Figure 2: Example of a transaction report prepared by the STD

In the final stage of the PUC tests, the robotised tools for improved mobile detection & in-situ forensic support were introduced to the end users.

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The **UAV** used for detecting explosives precursors in the air was presented. The UAV is an off-the shelf model, to which 3D-printed mounting brackets have been attached. The UAV thus securely carried a 3D-printed exact replica in size and shape of the T4i DOVER® Ultra (**D**rone **O**perable **V**apour **E**xaminer & **R**ecorder), which is a fast GC-PID chemical detector with a pre-concentrator unit optimized for vapour detection.

Flying tests of the UAV with the attached replica of the T4i DOVER® Ultra (Photos: P. Vasilev)

The **T4i DOVER® Ultra** was tested on the ground in action for efficiency and performance. These tests played a crucial role for validating the pre-concentrator unit within the cutting-edge

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ODYSSEUS technology framework. Not only did this test session contribute specialized technical discussions, but it also served as an opportunity for end-users to be introduced to ODYSSEUS technology and gain hands-on experience in the operation of the technology.

T4i DOVER® Ultra (Photo: T4i engineering)

Furthermore, the **UGV** used for collecting and detecting explosives precursors in water was presented. The UGV offers the possibility to explore and analyse unknown scenarios avoiding the exposure of LEA partners to a possible hazardous situation. With the sensors on board of the robot, LEA partners can evaluate remotely and in real time the situation and plan for future steps. Due to its design, the UGV can navigate through rough terrain and sort obstacles up to 10 cm making it suitable for outdoor and indoor environments. The UGV is designed with an interchangeable top that allows for the mounting of a robotic arm or the water sensor backpack depending on the mission. When using the water sensor configuration the UGV will be equipped with an actuated retractable pipe, which will allow LEA partners to take water samples from the sewer. The robotic arm is equipped with a gripper that allows the user to manipulate objects or

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actuate buttons in the scene remotely. The UGV is equipped with several RGB-D and thermal cameras that allow real-time streaming and assessment of the environment.

The real-time data received from these sensors was shown at the UGV's custom GUI platform as well as visualized in the Odysseus GUI platform. End users could visualize the real time position of the UGV in the map displayed on the Odysseus Dashboard, as well as check the RGB-D streaming coming from the front and back camera as well as from the Thermal camera.

Furthermore, the UGV integration with the Odysseus Platform was tested at connectivity and communication level to send UGV information gathered from the sensors into the Odysseus Platform where it could be consumed by other components.

Finally, end users had the opportunity to test the teleoperation of the UGV and its navigation through rough terrain with obstacles of up to 10 cm.

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Navigation tests of the UGV in rough terrain with obstacles of up to 10 cm (Photos: P. Vasilev)

The mobile MirSense Water Sensor, to be attached to the UGV was presented in the second iteration of PUC1.b in Vicenza.

PUC1.b in Vicenza

During the second iteration of PUC1 in Vicenza, the focus was directed on analysing water probes in the sewage system of a city, using the **Non-airborne Threat Detection and Localization** (NTDL) tool developed for ODYSSEUS, which can perform a forecast of the water quality. This tool complements the ODYSSEUS advanced vapour and water sensor for explosives precursors detection that is installed on a UGV, transmitting all analysis data to the ODYSSEUS Dashboard, which can then present the current threat assessment data to the end users.

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The NTDL's goal is to assess the probability of a certain site located within a sewer catchment to be or have been a potential shelter for non-airborne threat development. Therefore, the NTDL component relates measured data and synthetic data concerning the journey of any pollutant substance within a sewerage (e.g. ammonia).

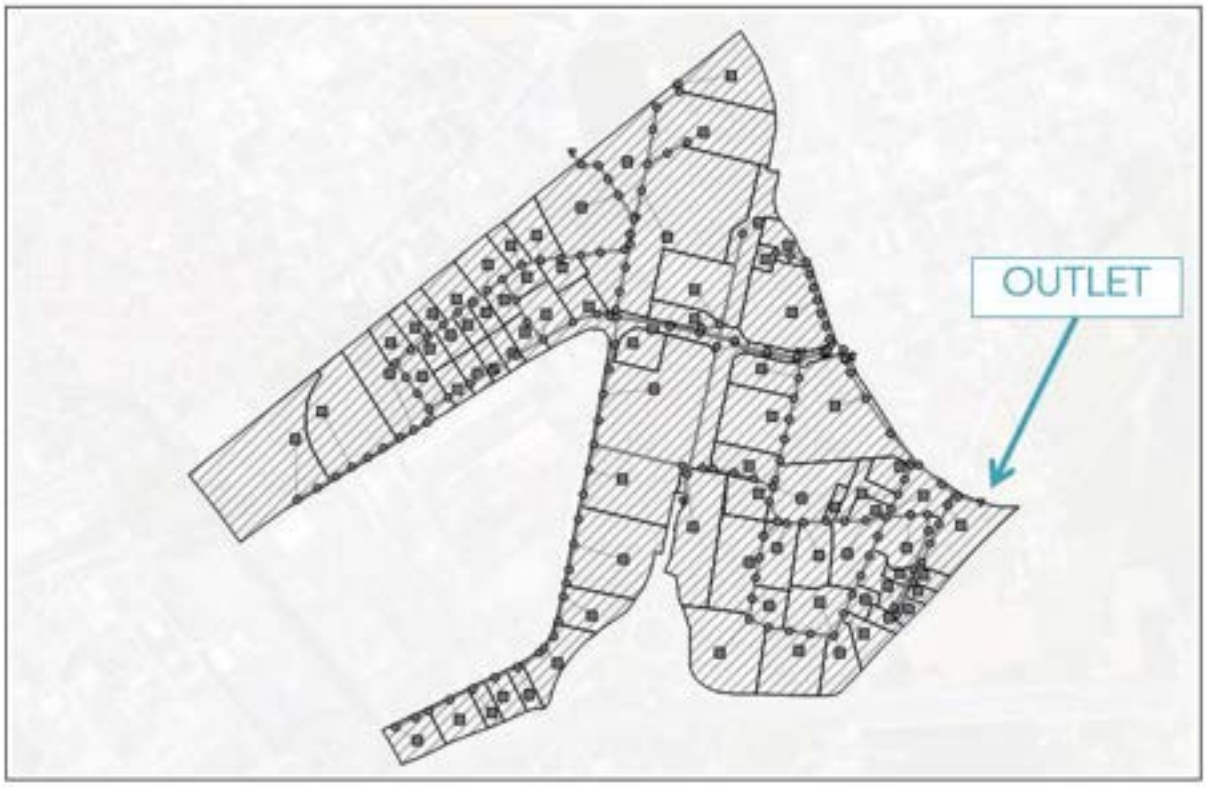

Figure 3: Map of an industrial zone indicating the locations of numerous inlets into the sewage system as well as the manholes installed for network inspection.

Firstly, a numerical algorithm solving for the advection-diffusion in a sewer network simulates all possible scenarios such that a dictionary of expected values referred to the network outlet (e.g., a wastewater treatment plant) is available in terms of concentration times and expected magnitudes.

Then, expected values and field values provided by sensor-equipped UGVs are compared and mutually crossed to obtain the

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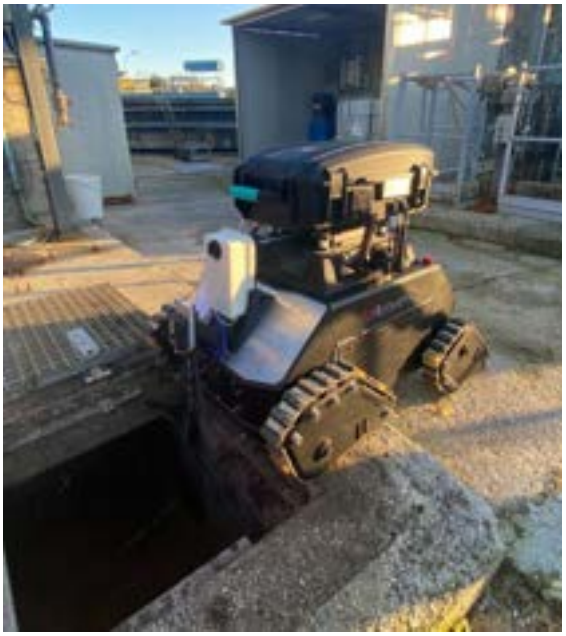
probability of upstream premises to be possible sources of the tracked substance.

In the first step of the PUC scenario workflow implementation, the NTDL tool was introduced to the participants, indicating the regular level of explosives precursors, such as ammonia, in the sewage water.

In the second step of the PUC, the ODYSSEUS UGV was sent to the sewage treatment plant in Vicenza to take a probe from the incoming sewage water. The UGV, which in addition to the navigation sensors and cameras presented already during PUC1.a, was also equipped for this PUC with the MirSense Water Sensor backpack for water analysis and with an actuated retractable pipe, which allows taking water samples from a source of water located underneath at 2-5 meters distance. Using the UGV's control pad, the users were able to teleoperate both the UGV and actuate on the Water sensor. With the control pad, the pipe can be extended or retracted and the pump, which supplies water to the sensor, can be turned on and off.



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The teleoperated UGV is taking water probes (Photos: Robotnik)

On the ODYSSEUS Dashboard, end users could follow the operation by the UGV per live stream from the UGV.

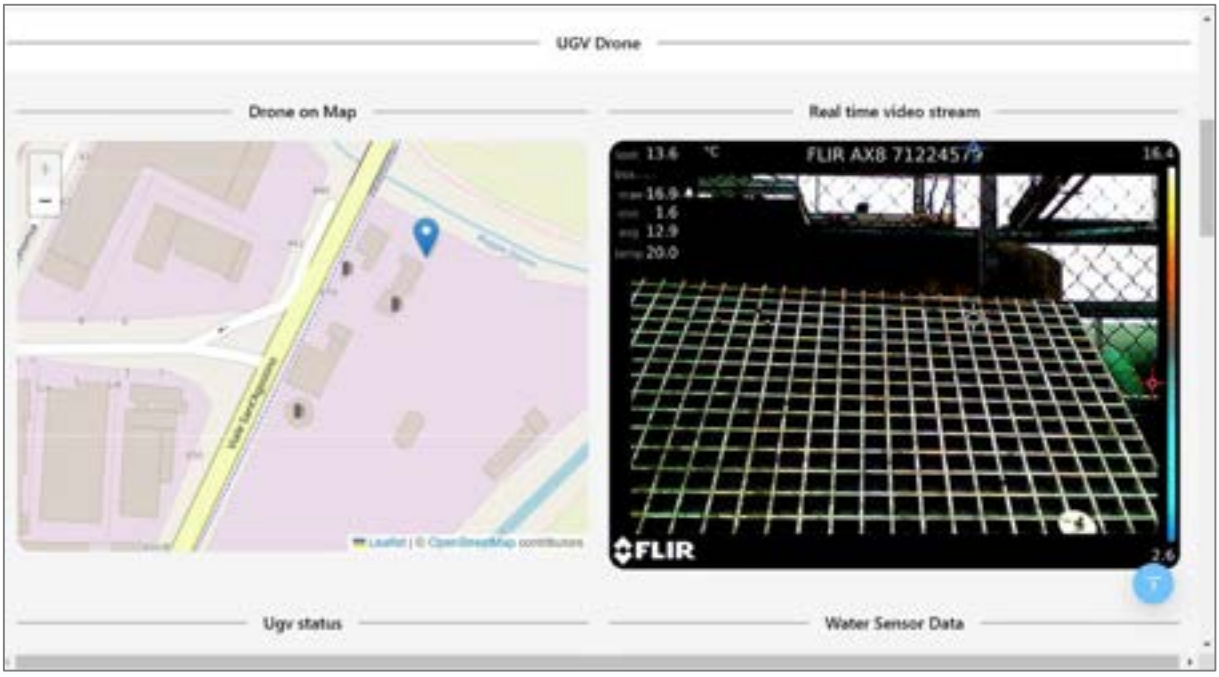

Figure 4: ODYSSEUS Dashboard – UGV stream and location

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Figure 5: ODYSSEUS Dashboard – UGV alternative camera view

Following the collection of the water probe, the MirSense **MultiSense water sensor** in the backpack of the UGV analyzed the water probe. The MultiSense sensor, designed for an innovative flash vaporization solution, enables the complete transition from liquid to gas phase. This automated solution serves as a plug-and-play mechanism, facilitating the seamless integration of the customized MultiSense. During the PUC, live recordings from the backpack where transmitted to the ODYSSEUS Dashboard, thereby validating the integration of the liquid sensor both mechanically on the UGV and functionally within the ODYSSEUS platform. The sensor was tested with both controlled samples and complex samples collected directly from the sewage to determine the ammonia concentration in the water. Following the PUC1.b, the transmitted data were analyzed to assess the accuracy of this novel approach in field conditions.

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Figure 6: ODYSSEUS Dashboard – Water Sensor data and UGV telemetry

In the final stage of the use case scenario workflow, an updated version of the Threat Assessment component, initially introduced during PUC1.a was demonstrated and tested once again taking into consideration measurements from the ODYSSEUS water sensor.

Both PUCs iterations were concluded with comprehensive evaluation sessions, where participants provided their feedback to the effectiveness of the tools. Further in-depth evaluations were conducted online after both PUC meetings, in which LEAs were asked to fill in comprehensive evaluation questionnaires.

The findings of these evaluations will be used by the technical partners to further enhance the design and functionalities of the ODYSSEUS tools to fully meet the needs of the LEAs.

The next PUC is planned to take place in Greece in April 2024.

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Other important events

ODYSSEUS consortium member T4i engineering is the winner of the 2023 European Commission Security Innovation Award

On 24th of October 2023, in the margins of the 2023 Security Research Event (SRE) in Brussels, T4i engineering received the European Commission (EC) Security Innovation Award for their product, **T4i DOVER®** *(https://www.t4ieng.com/t4i-dover-the-flying-detector/)* in a special ceremony. The award recognizes innovative solutions stemming from EU funded security research that have achieved significant success in market uptake of research results.

T4i engineering the winner of the SRE 2023 between the other 2 finalists (Photo: European Commission)

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Dr. George C. Pallis, T4i engineering Director, receives the award on behalf of T4i engineering (Photo: European Commission)

For more information, see the official EC announcement: *https://home-affairs.ec.europa.eu/news/2023-security-innovation-award-promoting-innovation-protects-security-eu-citizens-2023-11-09_en*.

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Joint Workshop of the H2020 projects ODYSSEUS and INHERIT

On 10 October 2023, the H2020 projects ODYSSEUS and INHERIT conducted their first joint workshop in the city of Vicenza, Italy. In this hybrid event, 27 members of both projects participated online and 13 on-site in Vicenza. The meeting was the culmination of various bilateral meetings of representative of both projects throughout the year in the framework of several international conferences and workshops where common interests and potential synergies of both projects had been identified.

ODYSSEUS and INHERIT representatives in Vicenza (Photo: P. Vasilev)

In their welcoming words the coordinators of both projects, Nikolai Stoianov (BDI) for ODYSSEUS and Hans Önnerud (FOI) for INHERIT highlighted these common interests and emphasized the openness of both projects for cooperation and their willingness to undertake joint activities in the future. They stressed the

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importance for both projects to be aware of each other's activities, to jointly explore research gaps in the field of detecting explosives and explosives precursors, share knowledge about new promising technologies and identify future exploitation opportunities for the results of both projects. Mr. Stoianov also highlighted that the partners of both projects together would represent almost all EU Member States.

The coordinators of INHERIT and ODYSSEUS (from left) during their welcoming remarks (Photo: P. Vasilev)

Following the introductory presentations to both projects by the two coordinators, a number of technical partners from both projects presented specific technical strategies and approaches in detecting explosives and their precursors.

While the ODYSSEUS partners presented their technical solutions in detecting explosives precursors substances in the

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sewage water (AAWA) and in the air (T4i) respectively, the INHERIT partners introduced their approaches in using the presence of (per)chlorate traces as evidence for the preparation of a bombing (NFI) as well as the use of markers in chemical precursors and techniques for their detection (FOI).

Following these technical presentations, the ODYSSEUS partner UNIVIE elaborated about precursors and related chemicals regulations in the EU and concluded with several suggestions for amending Annex I (List of restricted explosive precursors) and Annex II (List of reportable explosives precursors) of Regulation (EU) 2019/1148 on the marketing and use of explosives precursors.

The set of project presentations was rounded off by an introduction to the sister project INFINITY, which aims at transforming the traditional idea of transnational criminal investigations and analysis using immersive and collaborative environments in a common virtual reality workspace.

In their concluding remarks, the coordinators of ODYSSEUS and INHERIT once again highlighted the value of the workshop's contribution to the mutual awareness raising of the activities of both projects and the valuable questions that were asked and the comments made from the participants of both projects.

Looking ahead to 2024, which will be the final year of both projects, both coordinators were looking forward to a continued collaboration in 2024, which would include another joint workshop of the two projects, then to be hosted by INHERIT.

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