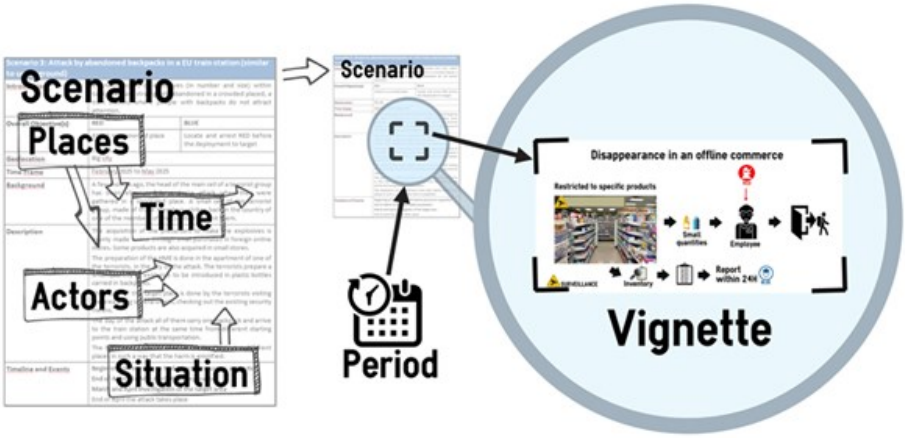
INHERIT Newsletter

Issue #3 - August 2023

INHERIT—INHibitors, Explosives and pRecursor InvesTigation

Exploiting INHERIT oucomes

INHERIT implementation impact will rely upon the estimation of effectiveness and risks of its countermeasures, and this will be enabled by an evaluation model applied across selected scenarios of interest, that are focused on the use of explosive precursors and HMEs to perform a terrorist attack.



The scenarios are fictitious, but based on actual types of IED incidents, extracting their main concepts, to finally elaborate a depiction of relevant and likely threats to be addressed. A wide variety of types of IEDs has been considered: LBIED, PBIED, SVBIED, VBIED, UXV-IEDs (UAV-IED, UGV-IED, USV-IED).

Different types of intended targets, delivery means and emplacements are covered: Airport, Train Station and Train, Seaport, Ships (Maritime), Gas Infrastructure, Nuclear Power Plant, Town Square, Shopping Centre, Administrative Building, High Visibility Event (HVE) – Stadium -, anti-person letter bombs.

These scenarios are structured in phases and are also depicted with vignettes, as graphical representations corresponding to specific events within the scenarios in limited periods of time. Finally, an evaluation is implemented by means of case studies, representing detailed single threat plots that should be prevented and neutralized by the INHERIT countermeasures. This evaluation model will contribute to assess the global impact of the project.

The evaluation model consists of a hierarchy of Measures of Merit (MOMs) that can be quantified using Multi-Criteria Decision Making (MCDM) methods. The MOMs are split into the effectiveness of the countermeasures and their risks.

In this way, the MOMs related to effectiveness include the different types of countermeasures covered by INHERIT: restrictions, dilution, inhibition, markers and forensics. As an example of such countermeasures and their evaluation, below are depicted restrictions, dilution and inhibition.

The adoption of additional restrictions in futures EP Regulations will increment the difficulty in acquiring the

(Cntd in p2)

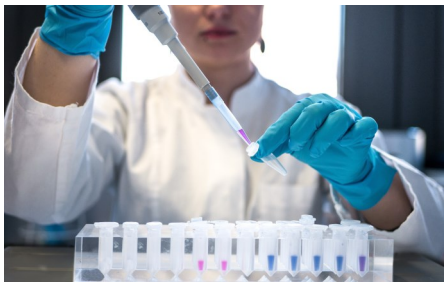
new banned products by terrorists and will hamper or preclude HME manufacturing with the permitted ones by means of the limitations applied to them. These increased difficulties should turn into the reduction of the number of HME-IED. In the context of the evaluation of new explosive precursors (EPs), the level of threat of a EP is obtained by means of a set of criteria that are used for prioritization and assessment and therefore for the analysis and development of future regulations.

Regarding dilution and inhibition countermeasures, the challenge is to make that EPs are not useful in the production of certain HMEs and at the same time achieve that the involved precursors maintain their functionality for commercial use and at a reasonable cost for the end user. The difficulty of manufacturing the HME is defined as a MOM that includes aspects such as the increase of quantity of products required, the necessity of additional lab tools and equipment, possible additional chemical products required, increase of cost and increase of time. All these aspects correspond to the increase of the logistical burden for the terrorists. In addition, the performance or explosive output of the HME manufactured is evaluated.

The MOMs related risks are divided into the following categories: human, economic, operational, environmental and health.

The MOM regarding the human impact of the countermeasures against the potential illicit use of EPs for HME manufacturing is related to the potential reduction of attacks due to INHERIT countermeasures, that would result in less deaths (saved lives) and injuries (saved injuries), which are indicators related to the consequences of IED attacks.

Besides the human impact of terrorism, terrorism entails significant negative economic effects, reducing the economic growth of countries and regions. The use of effective countermeasures against terrorism reduces the economic impact caused by attacks. On the other hand, the adoption of countermeasures also implies a cost, for example for economic operators. The evaluation is a balance between the benefits (reduction of negative economic effects) and the inherent costs.



Regarding operational risks associated to the application of the countermeasures, in the context of INHERIT no operational risks were identified and thus, the corresponding MOM can be neglected.

The use of inhibitors, markers and in minor importance dilution (i.e., more quantity of product required for the same effectiveness) make necessary the evaluation of the environmental impact due to employment of these countermeasures. An approach for the evaluation of the environmental impact is based on Quantitative Structure-Activity Relationship (QSAR) models that could be used to estimate chemical biodegradability. For example, markers that are electronic devices can be evaluated with particular focus on potential for bioaccumulation and degradation of their components, taking into account classification concentration thresholds.

Finally, the health (or toxicologic) risk is related to health concerns due to the employment of new substances in explosive precursors (inhibitors).

The quantification of these effectiveness and risks MOMs will contribute to evaluate the global impact of INHERIT countermeasures in the last months of the project.

Finally, it is important to mention that this evaluation model is within a framework methodology that intends to provide the EU commission with means to quantitatively compare the impacts of the INHERIT countermeasures or others suggested in the future, establishing a comparison with the current situation and assessing the potential enhancement.

How to reduce the use of HME precursors - from 'concept to reality'

INHERIT proposes to develop a multi-disciplinary approach to intervene across different stages of the terrorism timeline. INHERIT has assembled a multi-skilled team with experience in all aspects of four steps in this timeline: Prevent, Detect, Mitigate, and React. With a focus on explosive precursor chemicals, the project team develops methods and technologies directed towards thwarting the ability of terrorists to exploit these materials for the production of explosives. INHERIT pursues methodologies to render chemicals inert, more readily detectable, and capable of yielding better forensic value.

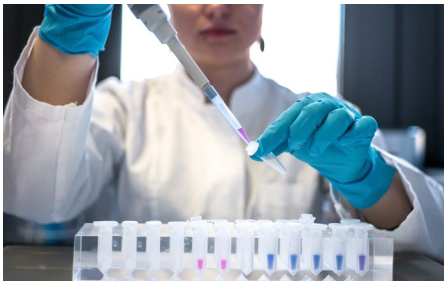
From 25-26 January 2023 a Workshop was held at TNO, Rijswijk, The Netherlands. This second Workshop (WS2) was a follow-on of WS1, organized by PSNI/FOI in June 2022 in Sweden, which mainly focused on prioritizing HMEs and precursors and identifying new, emerging threats. During WS2 new insights and progress on inhibition, markers and their detection and precursor forensics were used to review the required steps to go 'from concept to reality' to reduce the use of HME precursors. Other objectives of WS2 were to provide recommendations to the EC and to define the research focus for period 2 of the INHERIT project. Both workshops were attended by the INHERIT consortium partners and members of the Advisory Board.

During WS2 the participants were split up into four groups, each to address the different strategies of the INHERIT programme, i.e. dilution/inhibition (including synthesis), markers, forensics, and restrictions/ recommendations. The groups 'dilution/inhibition (including synthesis)', 'markers', and 'forensics' discussed the steps that need to be taken when applying a specific strategy on a new HME threat/precursor to go from 'concept to reality', taking into account the results and insights from the INHERIT research activities obtained so far. Furthermore, the prioritized list of HMEs and precursors (outcome of WS1) was used to assess the threat reduction potential of the different strategies (i.e. dilution, inhibition, markers, forensics, restriction) in real world attack plots/scenarios. By compiling all of the results, a top -down selection of HMEs and precursors was made, in this way guiding the R&D activities for period 2 of the INHERIT programme. The application of (electronic) markers is probably more interesting for enhanced detection and track-&-trace purposes rather than that these have a specific forensic benefit. The activities related to (electronic) markers are therefore to explore the detection capabilities of (electronic) markers in order to assess their benefit for different HMEs/precursors. For the identified emerging threats a knowledge gap was identified, specifically for tetrammine copper complexes (TAC-X). One of the activities within period 2 of the INHERIT programme will be focused on gathering more information on the synthesis and properties (sensitivity, thermal stability etc.) of these TAC-X complexes. Preliminary results on TAC-X complexes were presented at the "Research and Innovation Symposium for European Security and Defense" in Rhodes, Greece (29-31 May 2023) and at the "New Energetics Workshop" at FOI, Stockholm, Sweden (7-8 June 2023).

Finally, the group that discussed 'restriction/recommendations' identified a list of recommendations for an updated precursor regulation which are considered to help countering the misuse of new, emerging threats. In consultation with several members of the Standing Committee on Precursors (SCP) it needs to be decided what would be the best way to bring these recommendations to the attention of the EC.

Research visit at FOI Grindsjön

In april and may of 2023, Irene van Damme (University of Amsterdam) has visited the Totalförsvarets forskningsinstitut (FOI) in Grindsjön, Sweden. The aim of this research visit was to set up an experiment monitoring the persistence of erythritol tetranitrate (ETN) and hexamethylene triperoxide diamine (HMTD) fingerprints over time, under various environmental conditions. ETN and HMTD batches were synthesized by FOI. A silicone finger was provided by the Netherlands Organization for Applied Scientific Research (TNO) to make realistic fingerprints. The environmental variables to be analyzed were temperature (10, 20, or 30 °C), UV light (exposed or not), and the presence (or absence) of artificial skin perspiration and sebum in the fingerprint. The ETN and HMTD prints would be subjected to each possible combination of these environmental factors in triplo. During the two-month research visit, LC-Orbitrap-MS methods were optimized for the quantitative analysis of ETN and HMTD, the various environments were set up, the sample extraction was optimized and the 432 fingerprints were prepared. However, initial recovery tests revealed that inexplicably high amounts of the explosives were detected, sometimes even over 200% of the amount that should have been present in the print as measured by the balance. Until now, troubleshooting has failed to identify the underlying cause of these unrealistically high recovery rates. The quantitative results have yet to be compared to those yielded by alternative analytical techniques (LC-QqQ-MS or GC-MS). The fingerprints are currently stored in a freezer until the problem is identified and a reliable analysis method has been established.



ISADE 2023

International Symposium on the Analysis and Detection of Explosives

ISADE 2023 presentation

On september 12th 2023, Irene van Damme will present INHERIT work at the International Symposium on the Analysis and Detection of Explosives (ISADE). The presentation is titled ‘A study into the natural occurrence of ions relevant to forensic explosives investigation on human hands’. This study was a joint effort between the Netherlands Forensic Institute (NFI) and the Federal Bureau of Investigation (FBI). FOI, the Spanish National Police, and the Police Service of Northern Ireland assisted in the sample collection. In total, the hands of 278 participants were swabbed and the extracts were measured using Ion Chromatography coupled to Mass Spectrometry (IC-MS) to determine the concentrations of Li+, NH4+, Mg2+, Cl-, K+ , Ca2+, Na+, NO32-, SCN-, NO3-, ClO3-, Sr2+, PO4-, SO42-, ClO4-, and Ba2+. Separate quantitative anion and cation IC-MS methods were developed at the Netherlands Forensic Institute. The outcome of this work will support the activity-level interpretation of inorganic explosive traces on human hands and in fingerprints.

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INHERIT Meeting January 2023

The INHERIT Project consortium organized the Plenary Meeting and 2nd Workshop between 24-26 January 2023. The Meeting and the Workshop took place in Rijswijk, the Netherlands and hosted at the consortium partner TNO premises.

The workshop focused on the evaluation of the various precursors and inhibitors which are substantial part for the prevention of the production of Home Made Explosives (HMEs).
Apart from the consortium partners representatives, the workshop was attended by officials of the local authorities.

INHERIT project at RISE-SD 2023

The "Research and Innovation Symposium for European SECURITY and Defense" is an international EU Research and Innovation event in the field of Disaster and crisis management, Critical Infrastructure protection, Border security and Defence Research."

RISE-SD 2023 took place between 29-31 May 2023 in Rhodes, Greece.

INHERIT project was one of the 20 invited projects and participated with its own booth, exhibiting its progress and outcomes to an audience consisting of high-level representatives of the E.U., governmental representatives, researchers, industry, practitioners, and European security and defense stakeholders. Furthermore, the organizational plan foresees the publication of peer-reviewed papers related to the presentations that will be made in the sessions of RISE-SD 2023 in the Springer Book Series "Security Informatics and Law Enforcement."

The main topics of the RISE-SD 2023 included:

- Civil Protection and Disaster-Resilient Societies
- Critical Infrastructures Resilience and Smart Cities
- Better protect the E.U. and its citizens against Crime and Terrorism
- Protection of Public Spaces
- Effective management of E.U. external borders
- Enhancing defense of the E.U.
- Increased Cybersecurity
- Strengthened Security Research and Innovation

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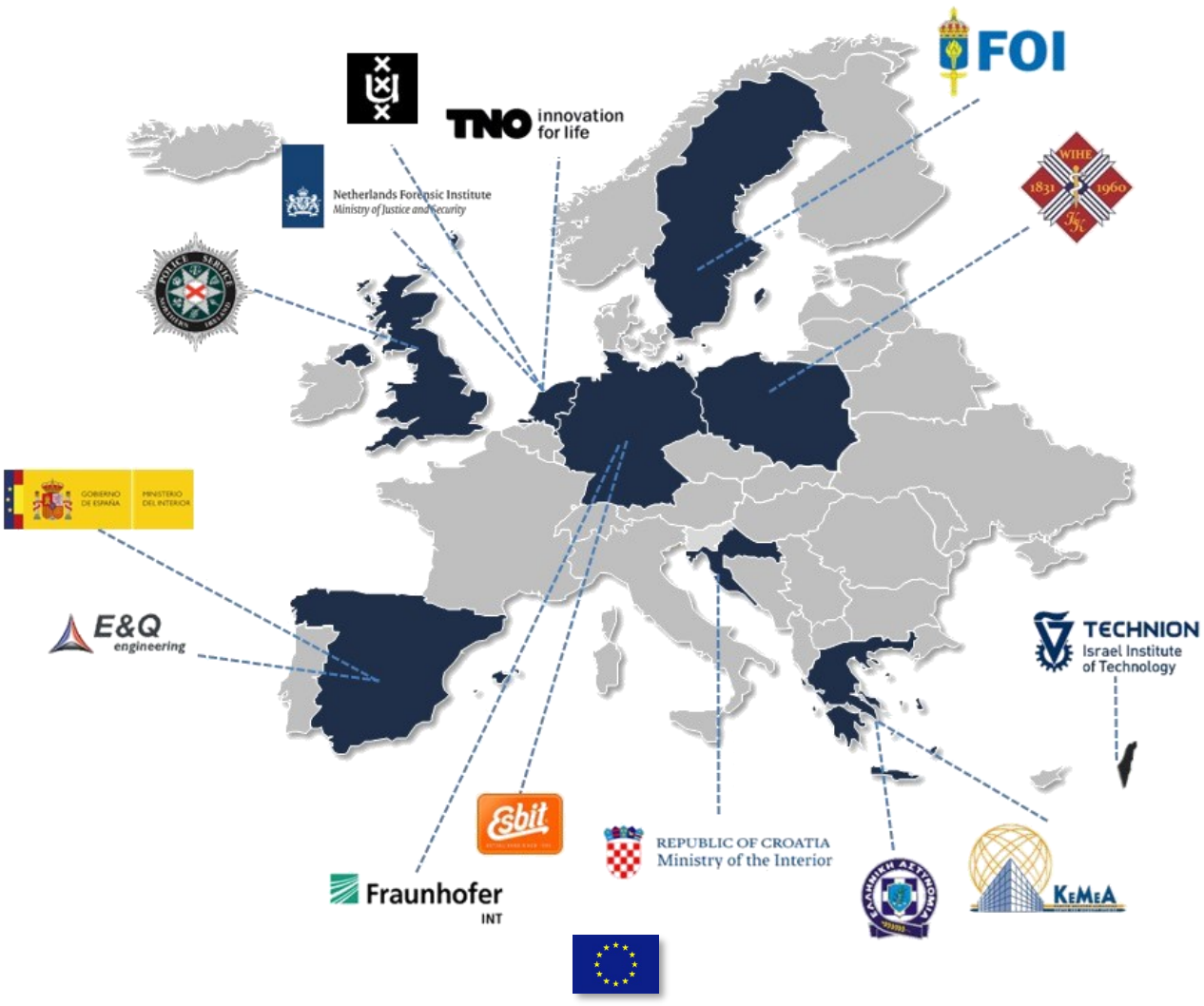

INHERIT Project is funded by the European Union's Horizon 2020 – Research and Innovation Framework Programme, under Grant agreement no: 101021330