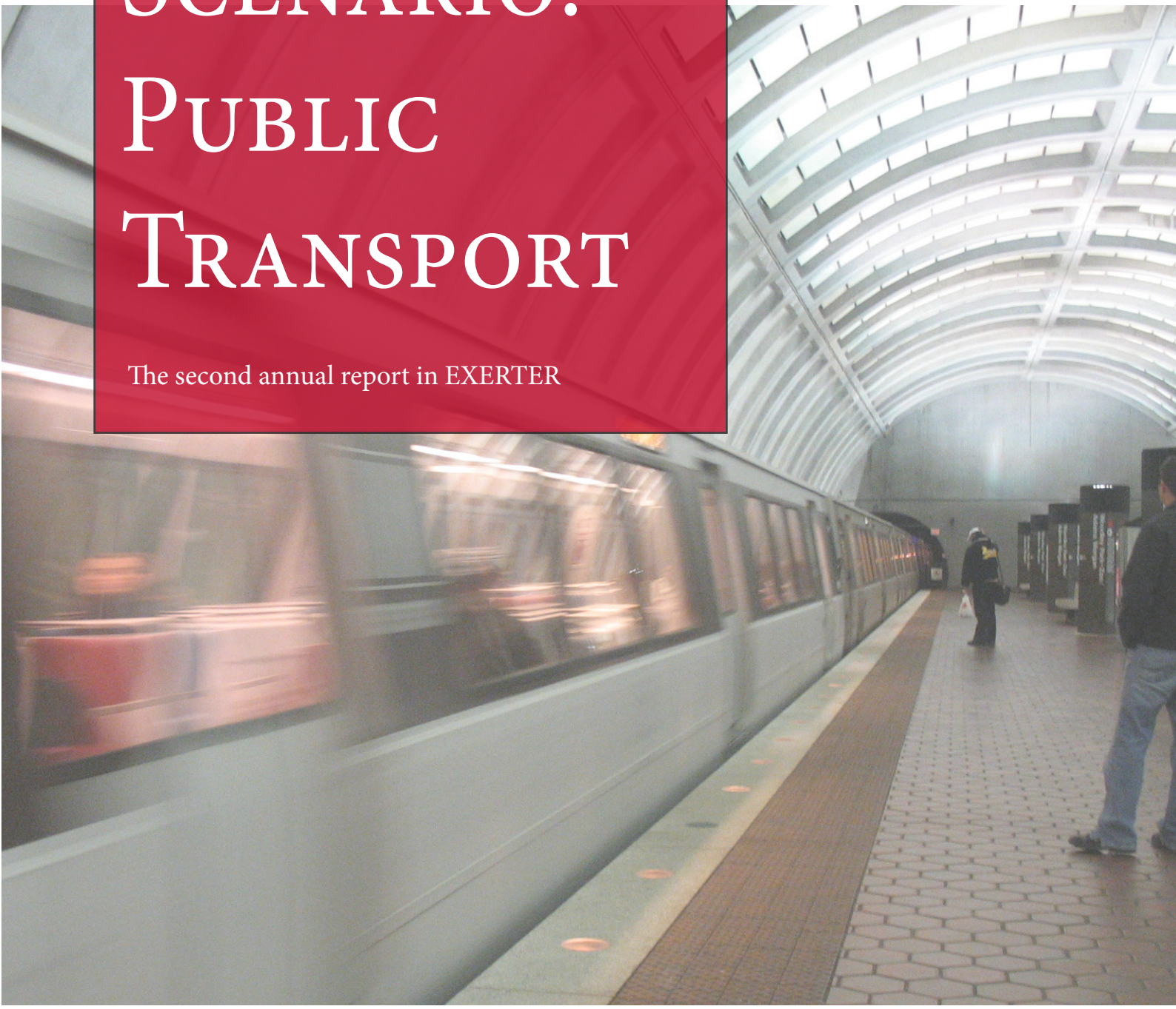
Scenario: Public Transport

The second annual report in EXERTER



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EXERTER
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Security of Explosives pan-European Specialists Network

EXERTER is a pan-European network that aims at identifying and promoting innovative methods, tools and technologies that will offer solutions in the fight against terrorism and serious crime, i.e. enhancing the overall Security of Explosives. The core of the EXERTER network brings together experts coming from Law Enforcement Agencies (LEA), Military Institutes, Governmental and Civilian Research Institutes, Academia and Standards Organisations.

By enabling the exchange of information about the challenges of countering current and emerging terrorist threats, the related operational requirements on methodologies, tools and technology and the status in Research and Innovation, EXERTER provides practitioners with the operative knowledge and tools for enhancing the security of our society.

Each year, EXERTER focuses on one attack scenario with connection to Security of Explosives. The scenario is a terrorist plot defined from planning to execution of an attack, and used to identify weaknesses in our response as well as potential countermeasure improvement. Focus is on the areas standardisation and certification, research and innovation and exploitation. The scenario for year two in EXERTER was a public transportation scenario, inspired by the 2004 Madrid attacks. A summary of the work, analysis and recommendations related to this year's attack scenario is presented in this report.

Information in this report is collected from the EXERTER report D6.4 - 4th Report on Innovations, Standardisation and Exploitation within SoE, v2.1, June 2020

Introduction

Each year, EXERTER defines an attack scenario, based on relevant input from practitioners and experts, and works with issues related to that scenario in all four domains on the terrorist attack time-line: PREVENT, DETECT, MITIGATE and REACT. EXERTER studies requirements, gaps and activities within research, standardisation and certification, and works towards exploitation of innovations within all phases.

Countermeasures under the four domains differ technically and operationally, and have different sets of users and stakeholders, thus setting a wide scope for the EXERTER network.

PREVENT concerns measures to hinder the plot in the planning phase, the DETECT domain relates to finding the perpetrator on their way to executing the attack, MITIGATE covers the aspects of protection and neutralisation, and REACT is post blast analysis and forensics.

This report summarises the outcomes of EXERTER from our work with a public transportation scenario based on the Madrid train bombings in 2004. It presents the findings related to the different counter attack domains and presents the concluding analyses and recommendations on future possibilities and needs.

In the beginning of EXERTER's yearly cycle, practitioners' requirements and gaps for countering the threat scenario was identified. These were based on input received from stakeholders and the expert community, collected during the EXERTER workshop in November 2019.

The information has been compiled in a classified report and formed the foundation for the continued work with the scenario. The final analyses and recommendations for the four counter attack domains are summarised here in this report.

The four counter attack domains: Prevent, Detect, Mitigate, and React

The Scenario

During the morning commute 10 bombs packed with nails and dynamite explode on trains heading towards central Madrid. The explosions kill 193 people and injure approximately 2,000. The ten IEDs explode in four different trains, and three additional IEDs are found after the attack: two are neutralized by controlled detonation, and one is defused. The bombs are contained in small bags and consist of commercial explosives and detonators that are triggered by mobile phone alarm functions. The time for the attack (morning with many commuters) is chosen to maximise the number of victims. The perpetrators are organised in one or more cooperating terrorist cells, and the explosives and detonators are acquired via criminals.

Prevent

The PREVENT domain is for this year's scenario focused on commercial explosives. Hindering the access to commercial explosives and IED components, as well as detecting and identifying them are the main aspects that are considered below.

Research initiatives

Most PREVENT research projects focus on homemade explosives (HME) rather than civil explosives, and no initiatives that directly apply to IEDs based on civil explosives have been identified. BONAS, EMPHASIS, LOTUS and SYSTEM are research projects that aimed, or aims, at detecting HME during the preparation phase. Although not fully applicable to the scenario, the techniques used may be able to detect commercial explosives as well.

Regulation & legislation

Legislation and control are considered the most important tools for countering the misuse of commercial explosives. Access to explosives can primarily be regulated through legislation and control. Directives at EU-level are covered by e.g. Directive 2014/28/EU, Directive 2013/29/EU and Directive 2008/43/EC.

Legislations, implemented procedures and control of explosives for civil use varies between different EU member states. Increased regulatory actions, preferably at an EU-level, could be one alternative for reducing the amount of stolen explosives and their illicit use. It is also important that procedures, controls and actions aim to cover the entire chain of transport, storage and use of the explosive, to prevent weak links.

Part of the EU-directives considers identification and tractability of explosives for civil uses. The requirement is to have adhesive labels, or printed information on the packaging. To introduce permanent markings on e.g. detonator bodies may be one solution that could assist improved traceability.

The carriage of hazardous substances is addressed in the ADR (European

Directives, treaties and conventions with relevance for security of commercial explosives:

- Directive 2014/28/EU, Directive 2013/29/EU and Directive 2008/43/EC
- The ADR treaty for transport of dangerous goods
- Convention on the marking of plastic explosives

Agreement Concerning the International Carriage of Dangerous Goods by Road) treaty. The ADR treaty contains security aspects and lists some general provisions to minimise theft or misuse of the transported goods. High consequence dangerous goods (meaning those with potential misuse in a terrorist event) are specified as a special category in the security provisions and these goods requires additional security plans. The security aspects for carrying dangerous goods could be an area for further study, particularly with respect to explosives not listed as high consequence dangerous goods.

Technical possibilities

Another approach in preventing theft and illicit use of commercial explosives is to add markers for detection (pre-attack) and taggants for identification of explosives (post-attack). Although such measures primarily concerns the DETECT and REACT domains, they are described here. Detection markers are substances that could enhance the possibility to detect the explosive with explosives detection dogs or technical devices. Due to the convention on the marking of plastic explosives, many countries already require markers to be added to this type of explosives.

The markers are volatile substances, which are present in high concentrations around the explosive and can e.g. be detected by specially trained explosives detection dogs. However, to assure that all dogs can detect explosives with varying marker

concentration, a need for guidelines regarding the handling of substances used in the training has been identified.

Research on different types of markers to be incorporated into explosives for civil use and explosives precursors could be one way of improving the possibility to detect explosives for illicit use. For such measures to have the desired effect, it is suggested that they are widely adapted across EU, integrated with the development of detection equipment and consider a wide range of societal perspectives.

Potential areas for further study:

- Stricter regulations for commercial explosives
- Permanent markings on/in explosives and detonators
- Carriage of explosives not listed as "high consequence" dangerous goods in the ADR treaty
- European guidelines for training of explosive detection dogs
- Increased system/use of detection markers and ID taggants

Detect

In the public transport attack scenario, the DETECT domain reflects detection of the IEDs and the people transporting it to the site of the attack. In the analysis the design of a station is considered, and the main challenges of detection in public transport are discussed.

Detection of terrorists or IEDs within a public transportation system requires detection systems that can scan a large number of people, preferably in free flow and without the need for any divesting. This poses technical challenges as well as highlights the need for a holistic approach to find suitable solutions.

Research Initiatives

There are several research projects focusing on the development of detection techniques. The NATO project STANDEX developed technologies to detect explosives concealed on a person moving through a crowd. Another, called DEXTER, aimed to develop a system to detect explosives and firearms in public spaces without disrupting the flow of passengers. The EU project SUBITO developed automated detection of abandoned luggage with fast identification and tracking of the individual responsible, and ADABTS focussed on developing automatic detection of abnormal behaviour and threats in crowded spaces.

There are and have been some European initiatives with the aim to increase harmonisation of certification and standardisation of the security in public transport. For example, efforts to map the needs were pursued by the ERNCIP thematic groups.

Standardisation & Certification

To improve the security of public transport against terrorist attacks, it is considered important to review existing security policies, procedures and technologies, and identify gaps and proposed solutions. A lack of consistency have been identified regarding the provision of security across EU, and there is currently no overarching security policy at the European level in this sector.

Developing a generic methodology for risk assessment for public transport systems and raising awareness of the risks among users of public transport could have effect. A coherent and standardised analysis of the risks and hazards, is beneficial to develop a common agreed process and layout for detection systems.

Train station design

The design of stations, including their interior, should also be taken in consideration when investigating the level of security in public transport. In recent years, the management of passenger security checks in train stations is following somehow the design of airport check-in areas.

It could prove beneficial to take similar approaches regarding the security of all passenger transport modes. However, to have a passenger check solution as known from airports is difficult for crowded train stations. For this reason, there is still a need for development of technologies that can facilitate improved security without interfering with the normal flow of passengers.

Technical Challenges & possibilities

The most innovative approach to pursue would be a system that detects remotely and in real time, without disrupting the flow of passengers and with a low level of false alarms.

The ideal detection would be fast, accurate, work from long distances, be safe for people, and able to detect threats through clothing or other masking devices with low false alarm rate and high probability of detection. However, today a single sensor is not able to satisfy all these characteristics well enough to be used as a stand-alone system.

Thus, there is a need for an integrated protection system, and at the same time, the detection of a threat could be based on both the behavioural anomalies of people and on the properties of the IED. All the information acquired could then be merged together in a more complex smart decision data fusion in order to enhance the detection performance.

Research is needed on the integration of information from distributed sensors to achieve real-time resolution and decision making with high effectiveness, and on integration tools based on data fusion and decision fusion. In addition, research on coupling parallel sensors via decision fusion with sequential sensor systems may provide valuable insights.

Technologies suggested for further development:

- Develop scanning technologies
- Implement and improve CCTV
- Intelligent video systems to track suspicious behaviour
- Facial recognition technology
- Cameras that track suspicious objects in combination with detection of explosives
- Sensor networks that collect environmental data and communicate to a security centre

Mitigate

In this chapter, the Mitigation possibilities related to the Madrid scenario are addressed. Research initiatives devoted to mitigate explosion effects in public transport systems are highlighted, and suggestions for future solutions are presented. Both structural and organizational measures that could diminish the effects of an attack have been discussed.

Research initiatives

Several research initiatives already addressed aspects of possible mitigation measures related to the effects of a terrorist attack on (or within) a public transport system. Potential mitigation measures in such environments are related to (i) organisational/management measures, as addressed e.g. in SinoVE Management, (ii) the structural design of passenger stations as addressed in SECURESTATION, (iii) the design of the means of transport as addressed e.g. in SECUREMETRO and (iv) innovative sensor technologies that could help to early detect suspicious situations, as developed in Sense4METRO.

Standardisation & Certification

Standardisation initiatives that might be relevant for attacks on (or within) public transportation vehicles are related mainly to structural components, such as glass (CEN, TC1299) and, in a wider sense, the design of buildings, sites and urban areas against criminal attacks and the management of transport facilities (e.g. CEN TC263 and 325). However, terrorism is not specifically included in these standards and, hence, their specific characteristics are not addressed. With respect to organisational measures, there exist many emergency plans, guidelines and procedures for other kinds of emergencies (as fires). An alignment, repurposing and/or expansion of these guidelines for explosion events could be a promising field for future standardisation activities.

Structural needs to mitigate explosion effects

Despite the progress of the research

Research on organizational measures is suggested regarding:

- Measures to reduce congestion in train/metro stations
- Evacuation concepts in case something suspicious is detected, for example based on existing emergency plans.
- Training of train crews, train station staff and first responders (police, fire-fighters, ambulance, bomb squad) with respect to fast evacuations, care about injured persons, prevent further attacks and IED neutralisation.

initiatives and technology developments on the design and structural properties of public transportation and passenger stations, the MITIGATION of explosion effects for the given scenario is challenging. The scenario, an attack on commuter trains in a metropolitan area, is characterized by a large number of people on confined spaces as well as the explosion influenced by the confinement of these spaces. Related to these characteristics, future research initiatives and technology developments on the structural or design side are presented in the box below.

Mitigate through organizational measures

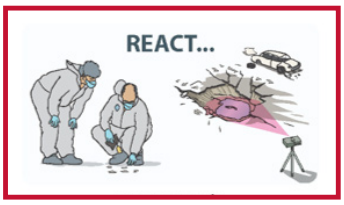
Despite past, recent and future research initiatives and technology developments addressing the mitigation of explosion effects on public transport systems, the success of these measures can only be limited. Many of them would either require considerable monetary efforts (i.e. to build every train blast resistant) or are almost inapplicable or even impossible (i.e. to avoid crowds in transport systems in metropolitan areas during peak hours).

Thus, especially the organizational measures are highlighted and suggested as a field of future research, as their implementation is most likely, compared to design/structural measures, easier and more cost effective.

Potential design solutions to mitigate explosion effects in public transport:

- Venting openings in trains, that effectively reduce overpressure conditions inside the train following an explosion.
- Separated luggage compartments, with basic protection measures in passenger directions (stable design, no fragmentation possible).
- Design train interiors in order to prevent hazardous fragmentation of structural components.
- Design train windows to prevent fragmentation, e.g. to protect people in metro/train stations from in-train-explosion effects – or the other way around.
- Design of metro/train stations to: minimize fragmentation, increase early venting openings, protect bearing columns to avoid structural collapse, instalments to generate safe protected areas reducing blast effects between adjacent zones, and avoid large crowds.
- Further development of IED neutralisation techniques.

React



The REACT domain covers emergency management, spanning everything from interaction between different organisations at the site and risk minimisation for first responders, to crime scene investigation. An overview of research initiatives in this domain and a selection on future development possibilities are given below.

Research initiatives

As shown in the public transportation attack scenario, critical infrastructure is still not hardened to cope with such an incident. Especially phone and computer networks have to be stabilized to avoid a collapse in the aftermath of a terrorist attack of such a scale. Nevertheless, there are several research projects that deal with improving the existing norms and crisis management on a local and international level.

There is considerable progress noticed regarding the growing number of projects and techniques dealing with the surveillance of public spaces. The possibilities of controlling areas, people and baggage in context with public transport systems have perceptibly improved, just as the quality of CCTV pictures has increased. At the same time, many of the projects also mention the data security aspects of such measures. The results are envisioned to help the direct response at the time of the incident but also in the later react phase to help the forensic investigation.

The research in the area of standoff detection of hazardous substances and explosives as well as in the field of forensic analysis is still conducted to a high degree. The EU projects HYPERION and CHEQUERS developed systems that can detect secondary devices and leftover HMEs at the site of an attack. Another example is the German project SUSQRA that aims to develop a software that can determine the extent of damage inflicted by IEDs, a tool that can be useful in the forensic post blast evaluation and evidence gathering.

The implementation of these techniques into best practice manuals or standardized procedures can nevertheless not be observed. Police- and forensic end users

are still a very small market, which do not justify large investments.

Finally, all measures that are taken as a result of research or as a reaction after an attack need to be transferred into standard operating procedures in the post-blast work and everyday routine. This typically takes quite a long time with large organizations, especially security conscious ones.

Standardisation & certification

Work on standardisation and certification regarding national and international procedures in the field of law enforcement, evidence gathering and post-blast work is still needed to work together at bigger attack sites. This is of course important on a national basis but even more so on an international (EU) basis, as attacks like the Madrid bombings can easily overwhelm the resources of many countries. Especially the number of specialized Explosives crime scene officers needed to resolve such scenes.

Even if information exchange regarding explosive incidents within the EU is on the right track to be done routinely through the bomb data centres, reaction and help by case officers in an emergency situation is not done routinely. This type of help can only seriously be offered and accepted if both agencies have the same standardized protocol of work at those scenes. Obviously, this would require an international (EU) certification system to ensure that the officers called to the scene produce evidence of such quality that they are valid in court. It would be equally useful if a similar standard training system could be used on a national level for first responders, getting them used to explosive attack sites.

Certifications targeting the reduction of risks, regarding the handling of hazardous chemicals are already in progress in several EU-States. This includes guidelines and requirements for warning systems as well as better personal protective equipment. First steps are made with the Standing committee of precursors concerning a standardized warning system for precursors used for HME production. Also, phlegmatisation of prepared HMEs could be implemented to reduce the risk of explosion when first responders work at the scene.

In addition, the monitoring of precursors that are already in use has to be expanded continuously in connection to the use of HMEs in IEDs. Here, simple and easily accessible information for sellers and first respond security forces needs to be included.

Proposed research initiatives in the REACT domain:

- Stabilize phone networks to avoid collapse in the aftermath of a terrorist attack.
- Improved surveillance of public spaces will help the forensic investigation after an attack.
- Standoff detection of secondary devices and leftover HMEs at the scene.
- Simulation tools that facilitate forensic investigation.

Concluding remarks

As the scenario of the train bombings in Madrid has been evaluated and discussed by EXERTER and its network, valuable insights could be generated in each of the four domains of the terrorist time-line.

The PREVENT chapter reviewed the directives, treaties and conventions in place today with relevance for the handling of commercial explosives. The implementation of detection markers that would facilitate detection of civil explosives was acknowledged as one potential future research topic.

The security of public transportation systems is already a widely discussed matter and there are several projects that focus on improving detection techniques today. Some main challenges of the DETECTION phase are the large flow of passengers on train stations and the implementation of an overarching security policy on the EU level.

MITIGATION of explosion effects in public transport pose a challenge and the mitigation chapter presented a selection of potential future research initiatives and technology developments regarding train and station design. Mitigation through organisational measures was suggested as a vital field of future research, and standardisation and legislation activities. For example, emergency plans, guidelines and procedures are widely available for other emergency cases, as fires, that could be repurposed or expanded with respect to explosion events.

Lastly, the REACT domain was analysed, covering both measures that could assist first responders and methodologies for forensic investigation at the scene of the attack.

Important needs of development have been highlighted as well as relevant research initiatives, which hopefully can play a role in the fight against terrorism and criminal activities in the future.

Please visit our EXERTER's web-page, or contact us for more information about our work and activities.

EXERTER consortium