[PRACTICE]

FINAL PROJECT REPORT

Reporting period 1 May 2011 – 31 Oct 2014

UNCLASS

SEVENTH FRAMEWORK PROGRAMME

PREPAREDNESS AND RESILIENCE AGAINST CBRN TERRORISM USING INTEGRATED CONCEPTS AND EQUIPMENT

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1. Executive Summary

The project *Preparedness and Resilience against CBRN Terrorism using Integrated Concepts and Equipment* (PRACTICE) set out to improve the preparedness and resilience of EU Member States and associated countries from an attack by a terrorist group using non-conventional weapons, specifically an attack with CBRN (Chemical, Biological, Radiological and/or Nuclear) materials.

Considering that the existing situation of CBRN preparedness is characterized by a fragmented structure in terms of technology, procedures, methods and organization on national and EU-level, PRACTICE developed a new Toolbox focusing on:

- Identification, organization and establishment of knowledge of critical elements in the event structure through studies of a wide selection of scenarios, real incidents and exercises;
- Analysis and identification of gaps in the current response situation, and organization and integration of the allocated response capabilities or functions in a Toolbox of equipment, procedures and methods; and
- An allocated system or public information kit for decision-support, First Responder training and exercise.

These response capabilities are to a great extent universal in character and independent of national organizational structures. The Toolbox concept provides EU and Member States with a flexible and integrated system for coordinated response to CBRN terrorist attacks, easily adaptable to various national organizations and regulations. Particular attention has been given to the integration and understanding of human factors and societal aspects. The final concept, Toolbox and subsystems have been tested and validated. At the end of the project the team delivers a fully functional and validated Toolbox prototype at Technology Readiness Level 6 with more than 40 newly developed or improved tools integrated into the PRACTICE Toolbox. Thus, the Toolbox serves and facilitates crisis management activities throughout the entire security cycle, from threat assessment over prevention and preparedness to response and recovery.

PRACTICE started on 1 May 2011 and run for 42 months. The consortium consisted of a mixture of small and medium-sized enterprises, industry, international and national organisations and research and education institutes, all together 24 partners from 11 European countries.

The research leading to the results of PRACTICE has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 261728. This was a non-classified project aiming at the civilian sector and improving its resilience against non-military CBRN incidents. Project results are therefore open to the interested public and have been posted on the project's website (**www.practice-fp7-security.eu**).

2. Summary description of the project context and main objectives

A CBRN crisis is very different from other risks to society. The most striking characteristic of CBRN incidents is that their effects are not limited to the duration of the incident, but that a large part of the effects follow after the incident itself, *e.g.* contamination of air, people, surfaces, objects and buildings. These effects can prolong the danger from an attack from hours to days or even years. It should be kept in mind that each of the type of hazardous substances behind the letters in the acronym CBRN has different effects with different timescales, affecting society in different ways. Another characteristic is that the potential psychological impact on the population as well as on the responders involved in dealing with the incident is very high, and will inevitably affect the operations significantly. A third characteristic of a CBRN attack is that the potential impact is expected to be considerably larger than that of a conventional weapons attack, and the size of the crisis in itself has a potential to put a number of most basic societal functions to a test.

Both preparedness and resilience relate to the ability of communities, groups, individuals and governments to respond to and recover from catastrophic events and major crisis. Resilience is a relationship between several aspects of society; people, infrastructure and organization, where all have their specific vulnerabilities and recover according to their own specific mechanisms. Any effort to improve the resilience must take into account relevant aspects of all these parts of society and the relationships that exist between them. The situation today, however, shows a fragmented picture evident in all aspects of response; technology, communication, command and control and information, terminology, routines and procedures. This fragmentation is even more evident when considering differences between EU Member States. Differences in organization, societal resilience, preparedness and even awareness of CBRN risks are to a large extent governed by culture, organizational setup of the cries management system, history, politics and a number of geographic and demographic factors.

The tasks (or functions) that are necessary when responding to a CBRN incident - before, during and after an event - are, however, to a great extent universal in character and not bound by distinctive national characteristics. Regardless of organizational setup, each nation has, for example, some kind of decontamination capability, procedures for mass-casualty management, communication protocols, et cetera. Focusing on improving capabilities and structuring the functions themselves is therefore a fruitful way of reducing fragmentation and improving the resilience against CBRN incidents both, at national and at EU level. Efficient and standardized planning involving well-defined, standardized practices together with a well-rehearsed preparedness in all stages of emergency response will lead to better use of available resources. It should also facilitate cross border sharing of resources like equipment, hospital beds or manpower. The knowledge that a well-functioning strategy is in place will strengthen citizens' confidence in the system. To a certain extent it might also deter potential perpetrators, if the effects of a planned attack can be kept to a minimum.

The changing nature of terrorism and the complexity of CBRN threats in combination with highly fragmented CBRN incident management systems across Europe have created a need for a European integrated CBRN crisis response system. Set against this background, the PRACTICE project (*Preparedness and Resilience Against CBRN Terrorism using Integrated Concepts and Equipment*) aimed to develop an improved system of tools, methods and procedures, the PRACTICE Toolbox, which provides the EU with the capability to carry out a truly integrated and

coordinated operational reaction following a CBRN crisis, caused either by a terrorist act or by accident.

Project PRACTICE addressed a multitude of activities required in order to properly respond to CBRN threats, bearing in mind that a CBRN crisis is very different from most other risks to society.

The nature of a CBRN incident requires an incident management toolbox to be a large system covering a broad spectrum of activities during the preparedness, response and recovery phases. Such a system also needs to cover technical, medical, human, societal and political aspects of disaster management. In addition, crisis management activities are conducted by a variety of actors, i.e. First Responder organisations like police, health and rescue services, but also owners of infrastructure and businesses, as well as local, national and international authorities. These actors are the natural end-users of such a Toolbox. User-specific interfaces have been designed for the PRACTICE Toolbox, since the end-users have different roles and responsibilities prior to, during and after a CBRN crisis.

Considering the fragmented situation and complexity of CBRN preparedness and response, the project focused on systematic features of CBRN incidents and matched them with appropriate societal capabilities and response functions. This is the core of the PRACTICE Toolbox concept. Actual tools, whether already existing or developed during the project, have been integrated into the Toolbox and jointly constitute a system that can easily be adapted to different contexts and levels of preparedness in different EU countries.

Several ideas and expected benefits motivated the introduction of a new CBRN incident management concept based on critical event parameters and operational response functions. First of all, the structuring of parameters and functions in a matrix provided us with a better tool to verify and map the status of different response capabilities and as a consequence to pinpoint needs and gaps. Secondly, it created the possibility to carry out systematic integration and coordination of response efforts in a formalized and repetitive way. Thirdly, the fact that the functions to a large extent are universal in character make the Toolbox and its information and training kits independent of national organizational structures, culture and specific regulatory setups. In this way, focus on functions also allows for a more efficient cross border cooperation. When roles in the functional system are identified, comparison of crisis management systems from different countries becomes easier and identification of the correct counterpart, *i.e.* actors in charge of same functions, becomes possible. In addition, focus on functions allows each national authority to adapt the system to their own particular organizational settings. PRACTICE does not foresee any imposed solutions. Rather the opposite – the Toolbox based on universal functions is by definition an open, flexible and easy to adapt system (SystemS of Systems approach, see also Stöven et al., 2014). Another advantage of a Toolbox based on functions is the ability to identify needs for developments and judge the importance of different developments. It also has the advantage of being able to compare the effectiveness of different Toolboxes.

In order to ensure that the PRACTICE Toolbox is useful to end-users and flexible as intended, the prototype was extensively tested by various end-users during practical validation exercises in three different EU countries, UK, Sweden and Poland.

The main objective, creation of a complete Toolbox and corresponding public information and training kits, was reached in a three-step-process:

1. Scientific foundation: Identify the current state of matters in CBRN Resilience and Preparedness, including relevant scenarios, critical event parameters and response functions.
2. Toolbox development: Design a new concept and architectural structure of incident parameters and response functions, and create an improved, integrated Toolbox with existing or new tools, equipment, procedures, training kits and public information kits.
3. Toolbox validation: Test, validate and refine the PRACTICE Toolbox with all its components through a series of live exercises.

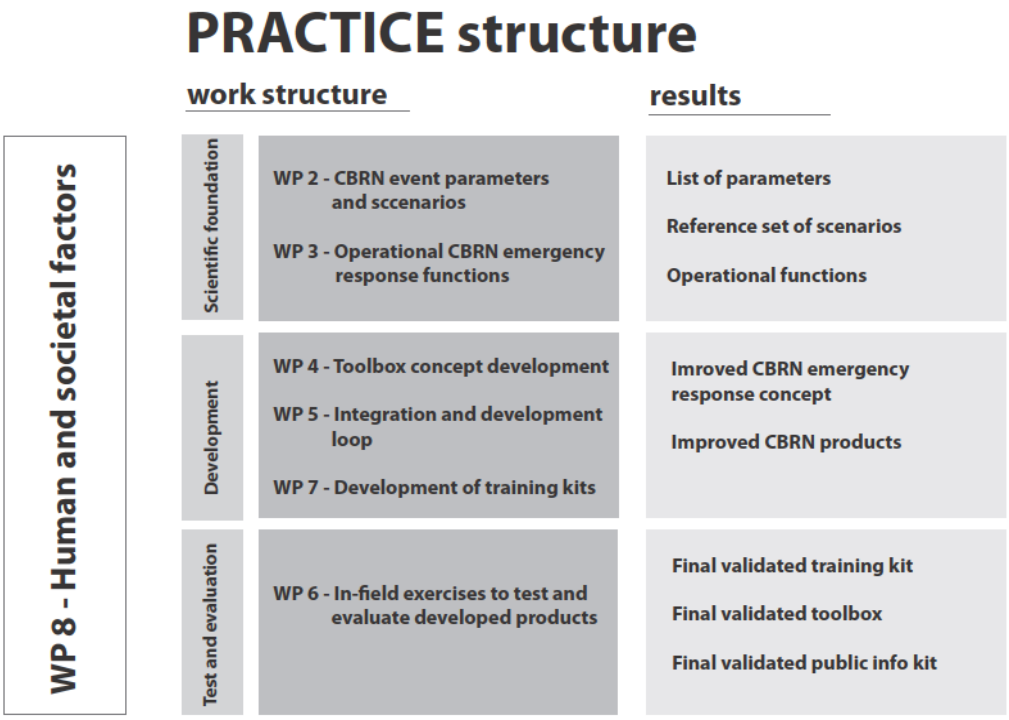


Figure 1: The work package structure of project PRACTICE

For this purpose the research and development work in the project was divided into a number of inter-connected work packages, each with its own intrinsic objectives:

WP2 - Scenarios and critical event parameters

- To produce a template for scenarios and requirements and use this to create a set of publicly available CBRN scenarios (not classified) that can be used by EU Member States for emergency preparedness planning, education, training and exercises.
- To identify, describe and organize sets of critical event parameters and observables characterizing the events, which First Responders and authorities use as input for selecting, prioritizing and developing appropriate emergency preparedness and response measures.

WP3 - Operational functions

- To identify existing operational functions and practices, training concepts, and standards used in Europe to prevent, prepare for, respond to, and recover from the effects of CBRN

events.

- To create an ideal set of operational functions needed to prevent and overcome CBRN incidents.

WP4 - Toolbox concept development

- To design an improved PRACTICE Toolbox for managing CBRN events. The Toolbox combines and structures main response functions and correlates these to critical event parameters based on input from WP2 and WP3.

WP5 - Toolbox integration and development

- To engineer a basic comprehensive Toolbox integrating sets of recommendations, standards, protocols, procedures and actual equipment based on the concept and requirements developed in WP4.
- To develop new or improve existing Toolbox components and tools as required by the analysis in WP4.
- To improve and further develop the basic Toolbox in an iterative process with stakeholders in the loop.

To validate and test by simulation all separate Toolbox functions as well as the total system.

WP6 - Field integration and validation

- To integrate and validate the outcomes of the project, i.e. Toolbox, tools and training kits, in real environments in a series of live exercises. The exercises covered different conditions and challenges related to CBRN threats. They were conducted by actual end-users in three different countries.
- To evaluate the improvement in preparedness and resilience brought about by the PRACTICE Toolbox.

WP7 - Training kits

- To develop CBRN crisis management training kits for First Responders and trainers, VIPs and the general public. The training kit is an integrated part of the CBRN Toolbox with a focus on man-machine interfaces and time efficient education.

WP8 - Human and societal factors

- To provide the PRACTICE Toolbox with information, procedures and processes for the understanding and handling of human and societal effects and influences of a CBRNE event (whether via terrorist or toxic industrial accident). The results were tested (via WP6) in order to explore the impact of the Toolbox information on existing levels of public knowledge and understanding about CBRNE events.

The research and development work was coordinated by the management team (WP1), warranting the scientific and technical quality of the work and the proper functioning of the consortium. Work package WP9 complemented the project activities through interactions with stakeholders and by promoting the project in various ways.

3. Description of the main S&T results

3.1 Scientific foundation

In order to understand how different parts of CBRN responses are structured, the project identified, described and organised sets of critical event parameters or observables characterising various types of incidents with hazardous chemical (C), biological (B), radiological (R) and nuclear (N) substances. These parameters included technical event parameters such as temperature, wind direction or concentration of a threat agent, but also human-related medical and/or psychological factors that influence response activities, as well as parameters related to intelligence information. The work was carried out through collaboration with First Responders and governmental authorities in the UK, Poland, Sweden, The Netherlands and Norway, who together with researchers discussed a selection of scenarios, results of previous projects and, of course, their professional experience. This work resulted in a set of eleven publicly available reference scenarios that outline the sequence of different response measures during all phases of a CBRN crisis.

In complement to the work with scenarios, another group of researchers focused on gathering and synthesizing existing knowledge about operational functions and practices, training concepts, and standards used in Europe to prepare for, respond to, and recover from the effects of CBRN events. We identified ways in which different EU member states and associated countries try to prevent CBRN events from happening, how they detect that an event is occurring, and how they discern between real events and hoaxes. A questionnaire-and-interview study was conducted with First Responders from across Europe, resulting in an overview of societal and crisis management functions affected by and needed throughout the cycle of CBRN preparedness, response and recovery.

Finally, a third group reviewed and analysed existing projects and state- of-the-art sociology research, thus advancing our understanding of the human and societal aspects of CBRN events. Improving the ability to manage individuals, communities and entire societies in the case of a CBRN incident are an essential part of societal resilience.

3.1.1 Scenarios and critical event parameters

The project collected information on historical cases of accidents and terrorist attacks which caused release of hazardous chemical (C), biological (B) and radiological (R) substances and publically available scenarios (Endregard et al, 2011). Inspired by and based on this information, a set of reference scenarios was developed (see **Table 1,** Endregard et al, 2012, Heireng et al, 2013). These scenarios all follow the same template and cover a broad spectrum of challenges for CBRN emergency preparedness and response. Three of the scenarios incorporate international consequences requiring cross European coordination, i.e. chemical contamination of a river, a biological pandemic and a nuclear scenario.

Table 1: Final selection of the PRACTICE reference set of CBRN scenarios (Endregard et al. 2012).

Scenario	Title
C1	Chemical attack inside building – Sarin dispersal through ventilation system
C2	Chemical attack in city center – Explosion and dispersion of sulphur mustard
C3	Chemical transport accident – Train derailment causing chlorine dispersal
C4	Chemical facility accident – Toxic waste release to river system
B1	Biological attack at airport – Influenza virus release in airplane
B2	Biological attack in buildings – Anthrax letters
B3	Biological attack on food supply – Bacterial contamination
R1	Radiological dispersal in city – Radioactive caesium spread in fire
R2	Radiological attack on public transportation – Hidden radioactive source
N1	Nuclear power plant accident – Release of fission products
H1	Hoax – Unknown powder in congress center

The scenarios reflect a variety of characteristics and properties of threat compounds and various types of locations (see **Table 2**).

Table 2: Scenario characteristics

Type of scenario	Scenario outline	Threat compound and key properties	Environment/ location
Chemical	Highly toxic chemical dispersed in building	Sarin Liquid, volatile Rapid onset of symptoms	Indoor Building
	Persistent highly toxic chemical dispersed by explosion	Sulphur mustard Liquid, persistent Delayed onset of symptoms	Outdoor Urban area Local
	Pressurised TIC dispersed due to train derailment	Chlorine, ammonia or sulphur dioxide Toxic gas	Outdoor Local
	Industrial toxic waste released in river system	Cyanide salts Water soluble	Outdoor Water supply Regional
Biological	Respiratory virus disseminated in airplane cabin	Influenza A virus (H1N1) Contagious Pandemic potential	Indoor International transport system Global
	Anthrax spores disseminated by the postal system	*Bacillus anthracis* Non-contagious Stable, spores	Indoor Postal system Regional (multiple)
	Attack on food supply	Entero Haemorrhagic *Escherichia coli* (EHEC)	Food supply Regional

Type of scenario	Scenario outline	Threat compound and key properties	Environment/ location
		Contagious	
Radiological	Radiological dispersal due to explosion and fire	Caesium chloride powder Caesium-137	Outdoor Urban Local
	Hidden radioactive source in train	Encapsulated radiation source Iridium-192	Indoor Public transport
Nuclear	Nuclear power plant accident	Fission products	Outdoor Regional
Hoax	Unknown powder found in building	Unknown	Indoor Building

The set of scenarios and their descriptions are publically available (Endregard et al, 2012). It can be challenging to describe hazardous scenarios, in particular intentional attacks, on an unclassified level. It requires a balance of sufficient detail fit for the purpose. The scenarios are based solely on open information, historical incidents and/or on previously published scenarios (Endregard et al, 2011). Also, the scenarios are kept at a generic and general level regarding location and other details. The scenarios are not the result of threat assessments, but constitute a collection of examples of possible CBRN crises.

The PRACTICE team used the scenarios to identify the parameters triggering specific responses in the handling of the incidents, *i.e.* the critical event parameters (Breivik et al, 2012). Critical event parameters are defined as *the observables triggering or determining the performance of a function*. A general approach to parameter-function interactions is:

1. You observe something (the parameter)
2. You analyse the observation
3. You perform an action (the function)
4. The action affects the observed system and your observation changes

Although the list of parameters is not exhaustive, it is a representative subset of CBRN-relevant parameters and observables based on a wide range of incidents and challenges. Critical event parameters were defined for each phase of the security cycle; i.e. the threat assessment, prevention, preparedness, response and recovery phases, with the main emphasis on the last two phases (see **Figure 2**). The parameters were grouped in two main categories: Key parameters triggering an operational function, and parameters that influence the performance of the function. Some occur only in one or a few of the phases of the security cycle, some are specific to the threat agent, and some are specific to the time or place of the incident.

Generic parameters influence the way in which a function is carried out and, thus, the level of success in the performance; these are not necessarily CBRN specific and influence both, the immediate response and the later recovery. Parameters specific to CBRN incidents include both, the observations leading to the conclusion that the incident might be CBRN related and the physical properties of the specific threat agent.

Figure 2: Security cycle with five phases, threat assessment, prevention, preparedness, response and recovery.

3.1.2 Crisis management activities = Operational functions

Operational functions are defined as those activities or tasks that need to be performed

i) to identify and to actively counter CBRN threats, and
ii) to be prepared for, respond to and recover from CBRN incidents.

Note, that operational functions are not specifically CBRN functions; they comprise all activities to be performed under CBRN circumstances.

An operational function can be visualised as a process with four 'angles' (see **Figure 3**):

- First of all, by performing an operational function a particular **goal/effect** should be achieved.
- Particular **resources** will be needed to successfully perform a specific operational function.
- There are probably several types of **conditions** that need to be fulfilled in order to perform the operational function, *e.g.* victims need to be decontaminated before medical treatment can be performed.
- Advance **input/information** is needed to start a function and in order to successfully perform an operational function.

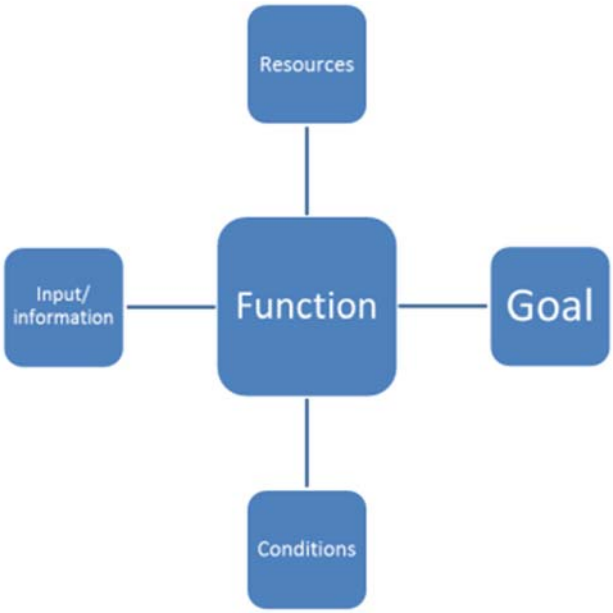


Figure 3: The four angles of an operational function.

A very important aspect that combines all these four 'angles' is *communication* (and the information that is exchanged through communication) between all stakeholders and involved network parties.

The project team initially extracted 66 operational functions for the complete cycle of crisis management from previous work in projects like IMPACT or ACRIMAS and from national procedures. Through literature reviews (e.g. incident reports), electronic surveys, individual interviews and workshops, mainly performed on CBRN experts, various types of First Responders and crisis managers from local and regional to national level from at least five European countries, the team investigated and assessed the current status of these operational functions and their four 'angles' (see Bastings et al., 2013). The discussions with stakeholders on their performance of operational functions were oriented on the reference scenarios described above.

In this survey it was particularly interesting to find out whether and how CBRN circumstances may affect the optimal performance of an operational function, and how the performance under CBRN conditions could be improved. Although the survey could not cover all operational functions with the same scrutiny, it provided a wealth of information about the CBRN security cycle and demonstrated the complexity and range of functions necessary to counter and to overcome CBRN incidents. These results were essential for fine-tuning an ideal set of 70 operational functions and for refining the definitions and interconnections of those operational functions considered to be most important in a CBRN context. For project PRACTICE this meant to identify those functions that should be addressed and improved by the CBRN Toolbox and thus needed to be primarily considered when designing the Toolbox concept. Other selection criteria were oriented on the tools developed in the project and the focus of the validation exercises. This work resulted in a selection of 19 operational functions, which were further explored in terms of gaps between the current and an ideal performance as well as in terms of possible and realistic solutions to bridge those gaps by the year 2020 (Bastings et al, 2013a). The results from this gap analysis have been translated into the architecture and the content of the PRACTICE Toolbox. But, even if CBRN-relevant functions can be improved with the help of the Toolbox the interdependencies of all operational functions and

security phases and their importance for efficient mitigation of CBRN incidents should not be forgotten (see **Figure 4**).

Table 3: Selection of CBRN relevant operational functions

Operatl. Function	Description
Threat assessment phase	
1-2	Conduct (national) risk and vulnerability assessment of areas and vital infrastructures/possible targets incl. OF3-5: Execute capability assessment in relation to threat/risk assessment
Prevention phase	
2-2a	Track and trace (dangerous) goods (including securing storage and transport export control etc.)
2-2b	Track and trace of water and food for CBRN contaminants
Preparedness phase	
3-2	Create public awareness (for early warning and mitigation of effects)
3-6	Develop and procure equipment and methodologies for First Responders
3-7	Develop and train emergency plans and CBRN protocols for First Responders and crisis management organisations
Response phase	
4-2	Determine scale of incident, propagation in time, appropriate security zones and level of response
4-3	Detect, sample, identify and monitor hazardous materials
4-4	Determine cause and origin of incident, preserve evidence
4-6	Assess consequences for (public) health, infrastructure and environment
4-8	Communicate with the media incl. OF4-32: Inform the general population
4-12	Secure affected area
4-18	Search and rescue
4-19	Manage casualties on-site (triage – treatment – stabilization)
4-20	Decontaminate people, (companion) animals and vehicles
4-27	warn population in surrounding areas
4-29	Register and trace exposed people
4-35	Mobilize and manage voluntary sector
Recovery phase	
5-3	Determine residual contamination level

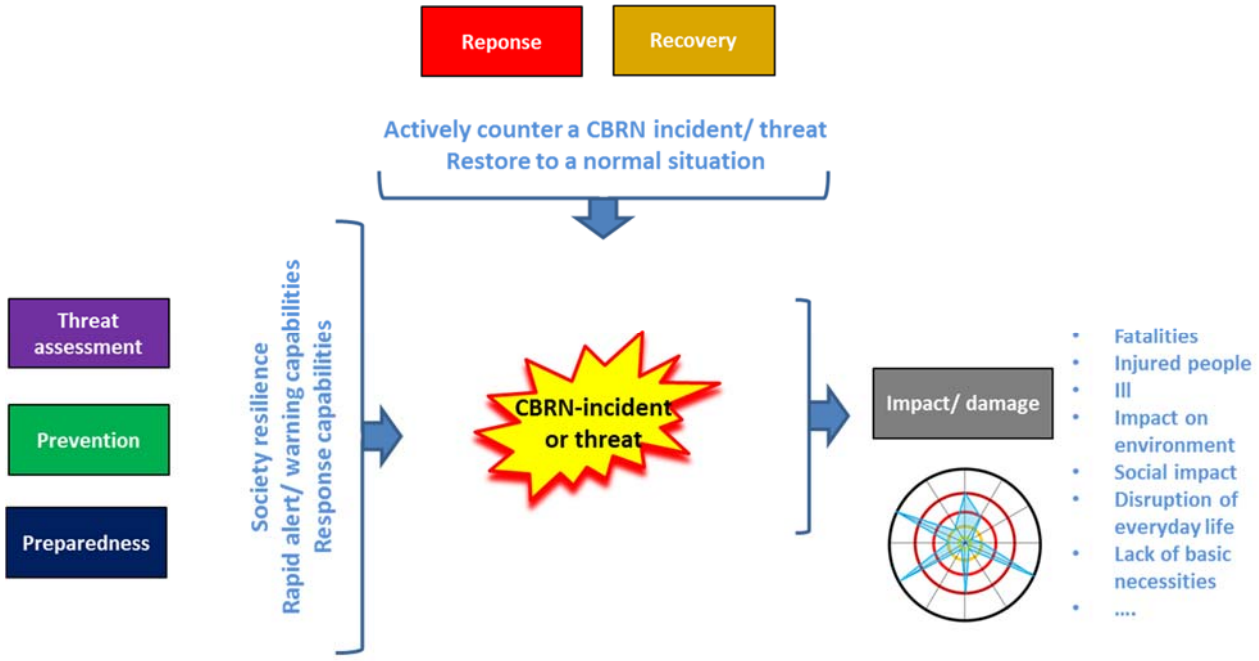


Figure 4: High level dependencies between the phases of the security cycle and subsequent operational functions

3.1.3 Human and societal factors

Understanding public responses is of key importance for improving the overall response to emergencies involving CBRN hazards as for example the psycho-social impact of CBRN incidents is often larger than the actual physical effects, and public behavior can interfere (e.g. spontaneous evacuation) but also facilitate (e.g. following official health advice) the response of the emergency services. Furthermore, research into public responses to such incidents is currently an emerging field built upon a patchwork of theories and based on limited systematic empirical research. Finally, emergency response organizations often engage with members of the public on the basis of under-informed and contradictory assumptions about public behavior, knowledge levels, information needs and communication preferences in relation to CBRN incidents.

The PRACTICE team therefore set out to develop a conceptual model to explain public responses to CBRN incidents. As part of this work the team held a stakeholder workshop at which public behavior, concerns and expectations was discussed with representatives of emergency response and crisis management organizations and various societal groups on the basis of the reference scenarios. The team compared national crisis management structures and the societal context of a number of European Member States and performed extensive literature studies and analysis of existing case studies (Sahovic et al. 2013; Usher, 2012; Krieger & Rogers, 2012; Amlot et al, 2013). All these efforts taken together resulted in a four-factor model of public responses to CBRN incidents, which combines insights from risk perception, risk communication, health behavior, trust, and crowd behavior theory. The integration of four different sets of factors explaining public behavior into one single holistic conceptual model reflects the complex amalgam of individual perceptions and social interactions that drives public behavior. The conceptual model also highlights the importance of contextual factors and the dynamic interplay between the factor sets identified on the

basis of existing research. While this conceptual model draws on existing research, the integration of existing theories into a holistic, dynamic and context-sensitive model provides a more nuanced and comprehensive understanding of public responses to CBRN incidents.

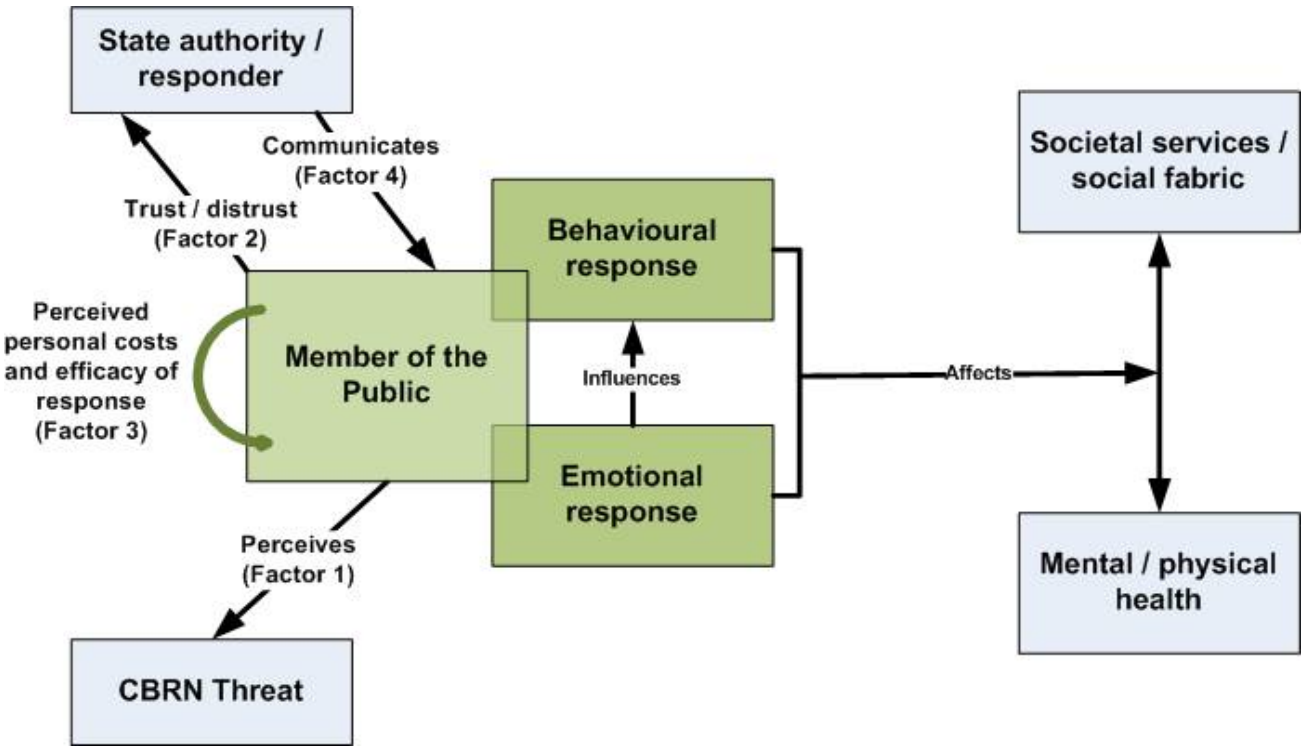


Figure 5: Four-factor model of public responses to CBRN incidents

Furthermore, during the validation exercises (see section 3.3) PRACTICE researchers collected a unique set of empirical data in order to test and advance our theoretical understanding of public responses to CBRN incidents (see Krieger et al., 2014 and 2014a). This data set is unique in its innovative character, diversity, and coherence. In general, the data set is concerned with two questions, namely to understand the drivers of public responses to CBRN incidents and to assess the views of emergency professionals about the behavior, knowledge, emotional responses, information needs and communication preferences of members of the public in relation to CBRN incidents.

The key innovation is that data was collected before, during and after a live exercise that involved unscripted public volunteers with limited prior experience of emergencies and emergency responses. The data collected from the public volunteers in the context of the exercise therefore differed from much of the previous research that relied on desktop scenarios, focus groups and surveys by including the direct experience as a group of a multi-stage CBRN emergency response. Moreover, in the context of the exercise, data was also collected from emergency response professionals, who – in the exercise context – conventionally deal with scripted actors rather than 'real' members of the public.

The diversity of the data set is reflected in the use of multiple methods (focus groups, surveys with open/closed questions, semi-structured interviews), the collection of different types of data (oral, written, qualitative, quantitative) at different points of time (before, during, after the exercise) in different countries (18 European countries, in particular Sweden and the UK). At the same time, all data collection tools used the same chemical attack scenario in order to ensure coherence and comparability of data.

What we learned from the data (and the theory) is, among other issues, that

- social interactions, in particular the communication of information, among members of the public and between the public and responders are of central importance in shaping public responses to CBRN incidents;
- public information needs to evolve dynamically as the incident unfolds, reflecting changing public perceptions of the threat, the responders and response measures;
- communication with the public needs to manage public expectations regarding response measures and resources;
- public communication has to provide forward-looking procedural information and a rationale for the measures;
- members of the public prefer direct and verbal messages to automated systems;
- Emergency response professionals across Europe generally view public communication as part of the overall emergency response but the perceived importance of public communication may vary, depending on target audience, response phase, message content, and country of origin of the professional.

These insights into public behavior and expectations have thereafter been used to inform public education material and guidance about public responses to CBRN incidents for emergency response professionals. Moreover, the data has been used to further develop and refine the so-called resilience matrix, which is a tool that assists crisis managers, leaders of organisations and businesses in assessing the vulnerability or resilience of a societal group to CBRN incidents.

3.2 Toolbox development

The scientific results described above were translated into a format suitable for the Toolbox developers, to design and improve the Toolbox concept, to construct an initial version of the Toolbox itself, and to produce and integrate the first tools. The correlations and interactions between main response functions and critical event parameters make up the base of the Toolbox concept. Thus, these interactions were transformed into Toolbox functions that support decision processes throughout CBRN crisis management and preparedness. These Toolbox functions in turn were connected to suitable tools of different types, newly developed in the project or already existing. This design was then tested for implementation constraints and connector accuracy.

3.2.1 The Toolbox concept

The first step in designing the Toolbox concept was to define the effect goals of the Toolbox:

- Faster and more precise response to a CBRN incident: This can be achieved through faster exchange of information between all organisations involved and between users at different levels in the same organisation. This again could be facilitated through the integration of multiple sources of information in one layered picture. By having access to all relevant incoming information near real-time, the users will be able to assess and analyse the information in a timely manner, leading to quicker decisions founded on actual data.
- Optimize the use of resources: By tracking and tracing resources, both personnel and equipment, updating their availability and status and also time-to-arrival, decisions can be made so as to manage the resources in the most efficient way. Optimizing of resource spending will also lead to faster return to normality.
- Increase the awareness among responders: CBRN incidents are relatively rare events, giving few responders the experience necessary to feel comfortable in handling them. Through training and simulations the responders can familiarize themselves with the general principles for handling events including CBR agents, as well as being drilled in using specialized tools.
- Increase the awareness among the public: This can be achieved through tailoring information to different demographical and professional groups. Guidance on crisis communication should be provided.

From these effect goals the top-level functionality of the Toolbox was derived. It is important to note that the Toolbox was designed as a support system guiding and helping the user, in contrast to a decision making system providing a definite answer. The Toolbox is a framework for organizing tools and making the right decision based on what the Toolbox has been populated with, rather than a system of systems that are fixed and ready to be used on delivery. It is flexible towards which tools are connected, and the end-users are able to insert their local information and tools. Thus, the end-user must be involved in implementation and customization of the Toolbox. This ensures that the Toolbox can be adapted to different uses and varying circumstances and also, importantly, can be expanded as needed later in time. However, in its most generic form the Toolbox also provides a minimum solution that is valid anywhere. An outline of the overarching structure developed is given in **Figure 6**.

The blue boxes in Figure 6 represent the intelligence in the Toolbox:

- The situational awareness system is a live updated system of layered information. The data can be entered by a ‘man in the loop’ or can be pushed or pulled from electronic sensors. The layering of information enables the various users to choose what information is relevant at any given time. The most relevant layers are presented for any given role. This also makes it possible to give each layer of information a security classification, restricting the access to only those with the necessary clearance.
- The decision support system is a tool in itself, guiding the user through the most important steps that must be performed. One possibility is to enter the observables (symptoms and physical properties of the threat agent) in order to obtain suggestions for which agents could be involved in the situation. There are decision support trees for identifying the agent in question and specific trees for the differences in the handling for radioactivity, chemicals and biological agents respectively.

The green boxes represent different types of tools (see list below). These tools can be existing hardware or software, or tools developed through the PRACTICE project. The level of integration varies from deep integration to simple referencing. For existing hardware, the connection is through the user; for a given situation, the tool is suggested in order to handle one specific aspect, and the user must then deploy the tool.

- "Direct link to experts": Validated experts nominated by governmental organizations can be registered as tools in the Toolbox. In the highest level of integration they would be a Toolbox user and be able to follow the development of the crisis directly. On a lower level only the expert's contact information would be registered.
- "Observation tools" provide information to the system. Such tools can not only be automated electronic sensors, but importantly, also human observations reported and entered into the situational awareness system by a 'man in the loop'. The observational tools can be regarded as the permanently live part of the Toolbox that can trigger the use of the dormant CBRN relevant Toolbox.
- "Databases of live information" contain information related to a specific event and are updated near real time. This could be achieved by linking to authorities responsible for national and/or international databases as well as keeping local Toolbox internal databases. Examples would be meteorological data, traffic information and availability of resources.
- "Databases of static information" contain generic information that is not related to a specific event. This information is pre-produced, quality controlled, properly indexed for fast retrieval and should be updated regularly. Examples would be cartography, site specific risk assessments and agent specific data sheets.
- "Action tools" are the tools necessary to handle the event. These can be software tools directly linked to and accessible through the Toolbox, or hardware listed in databases accessible through the Toolbox, or even documents with guidelines, recommendations or protocols.

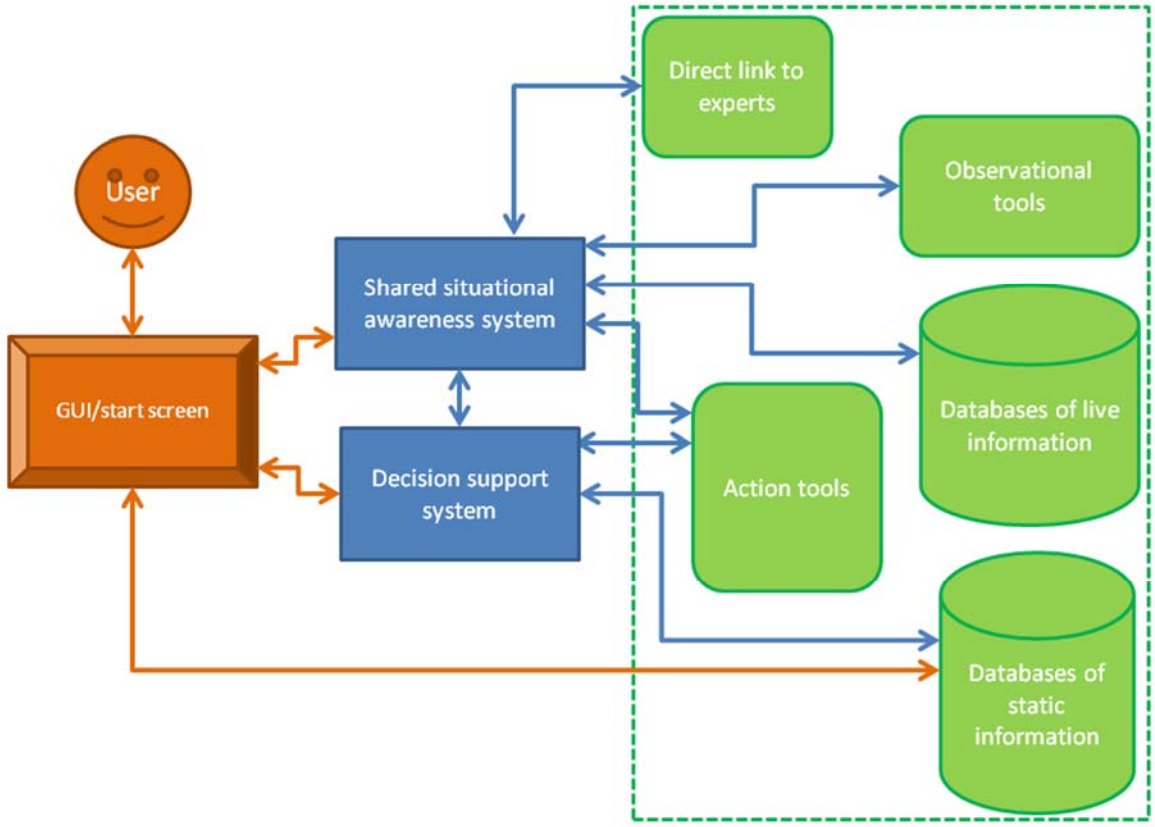


Figure 6: Outline of the Toolbox concept with user side in orange, the intelligence in the system in blue, and different types of tools providing information to the system in green. Arrows indicate communication flow, GUI = graphical user interface.

3.2.2 Toolbox system requirements, tool integration possibilities and user interface

A list of 14 operational requirements, some with sub-requirements, that served as input to the construction of the Toolbox and formed the basis for how the Toolbox should work, were identified:

1. Ability to **handle the whole range of incidents** from small scale to international and from immediate effects to slow onset of symptoms.
2. Possibility to **accept input** information in real time. The input must follow specific standards.
3. Ability to **present information** to users.
4. Must provide **quality controlled information** on CBRN, e.g. guidelines and procedures. The information must follow specific standards.
5. Possibility to **search** for stored information.
6. Possibility for **decision support**. The decision support system should offer the user the possibility to evaluate different kind of actions and suggest a course of action. It will not give absolute answers, but suggestions only on how to handle a situation.
7. Possibility to **connect to expertise**.

8. Possibility to **analyse information** provided.
    a. Possibility to read out data from single sensors.
    b. Possibility to perform predictions based on input data.
    c. Equipment affected by meteorological data should be marked as “not possible to use” when e.g. temperature is too high or low
9. **Sharing of information** between different users. Possibility to share situational awareness
10. Increase the **awareness** among the **public**. Pre-prepared information packs, static databases that is easy accessible
11. Provide response **training** possibilities
12. **Improve the use of resources**. Possible to log where different resources are, their (people and equipment) capabilities and limitations.
13. Possibility to **expand the Toolbox** at later stage
    a. Possibility to add newly developed tools
    b. Possibility to edit tools
    c. Possibility to add tools at the request from new Toolbox users
    d. Possibility to in the future be the main system in use
14. Possibility to adapt the Toolbox to **different cultural aspects** (language, ethnical groups, national requirements/laws, etc.)

At the end of the project the Toolbox prototype fulfils all the above requirements, but it is a Technology Readiness Level 6 development and its form and content will strongly evolve before reaching the market. Two graphical user interfaces have been implemented: one for the general public linking to the publicly available part of the Toolbox with a real-time crisis information exchange function and access to the stored recommendations for the public affected by a CBRN incident; the other interface requires a login and is addressed at end-users and technology providers.

Thus far, tools have been integrated in the Toolbox at four different levels (see below). Tools that require parameter input from the user in order to produce an output should be integrated at least at level 2, preferably at level 3. Level 4 was introduced to facilitate exchanges with tools without specific constraints on their interfaces. Higher level integration for automatic communication between tools is possible in the future.

Level 1: The tool is referenced in the Toolbox tool catalogue

Level 2: Tools like manuals, procedures, guidelines etc. are stored in the Toolbox in various file formats and can be downloaded.

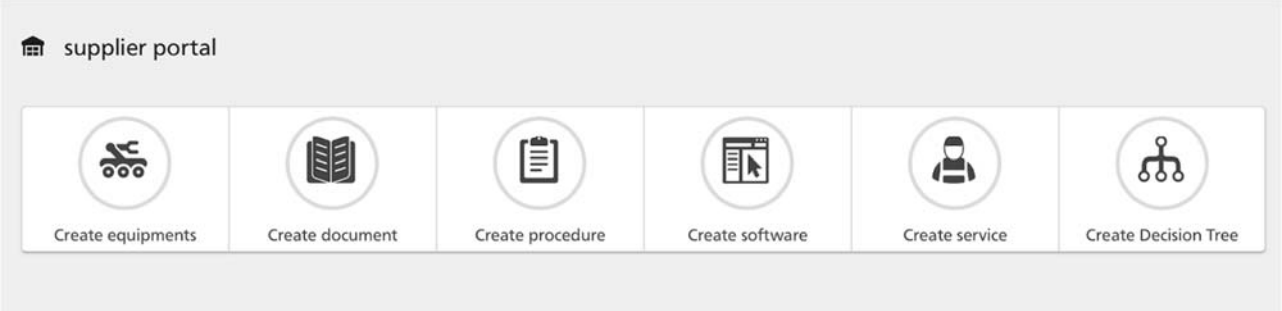
Level 3: Tools like software programs are used via the Toolbox; exchange of data between tool and Toolbox using web services; requires “man in the loop”.

Level 4: Tools can exchange data with the Toolbox via FTP as a generic level that is easy to implement for tool providers, as for example for tool output like documents and images.

3.2.3 Novel and refined PRACTICE tools

The development and improvement of tools for CBRN crisis management was a big part of project PRACTICE. Two entire work packages were dedicated to produce novel solutions to the needs of First Responders and crisis managers, mainly during the preparedness and the response phase. Besides work packages WP5 and WP7, tools were also developed by WP8 and results from other work packages were integrated in the Toolbox as extra resources (e.g. reference scenarios, exercise and evaluation methodology) or were translated into functionalities like a questionnaire guiding the initial understanding of the character and scale of an incident or the possibility to build flow charts for planning purposes.

The Toolbox handles Tools from various categories as illustrated in the following screenshot.



PRACTICE tools facilitate the four effect goals of the Toolbox (section 3.2.1) and can be grouped as

- Observational tools supporting situational awareness (communication/information exchange, birds eye view camera, connections to on-line sensors),
- Database of live information (maps, location of available resources),
- Database of static information (guidelines, recommendations/protocols, CBRN knowledge and information, scenarios),
- Action tools (sensors, modeling software, Track & trace).

More than 40 tools have been integrated in the Toolbox, most of them were either newly developed or further improved within project PRACTICE. Half of the tools address issues highly relevant to all types of CBRN incidents; another quarter of tools addresses at least one of the ‘letters of CBRN’, while the rest complements the CBRN-specific arsenal with ‘generic’ functions that are universally applicable to all crisis management (see **Table 4**). The Toolbox includes a large number of guidance documents and protocols intended to inform preparedness, planning and training activities. These were developed on the basis of intense literature studies, on best and good practice in EU Member States and on empirical research. For example, the results of the work in WP8 lead to the creation of three communication manuals that inform and prepare members of the public for CBRN incidents and help emergency responders to effectively engage with members of the public before, during and after a CBRN incident. These three tools target different audiences: The first one is a public information manual directly aimed at members of the public. It contains information about CBRN incidents, the emergency response to such incidents and what kind of organizations are involved in the response. The second manual offers guidance to emergency professionals on the ground about public behavior, emotional responses, information needs and communication preferences in relation to CBRN incidents. The third tool was designed for strategic leaders and offers generic guidance on

how to prepare, organize and execute communication with members of the public before, during and after a CBRN incident.

The manuals are unique due to the fact that they are based on robust theoretical and empirical foundations. For instance, the manuals are structured in accordance to the phases of the emergency response in order to enable emergency professionals to address the changing information needs as an emergency unfolds. Other examples of how theory and data influenced the design of the manuals concern message contents, e.g. the message 'please be patient' (managing public expectations regarding the speed of response) or the emphasis on the need to provide a rationale for each measure (e.g. disrobing removes contaminant).

The resilience matrix, which has also been refined based on the research results on human and societal factors, facilitates an assessment of a group's or a community's estimated societal resilience. Such information can be very helpful for strategic and political leaders during the preparedness phase when planning and prioritizing crisis management activities.

Table 4: List of PRACTICE tools provided by consortium partners with advancement in technology readiness level during the project, CBRN relevance and Toolbox integration level.

Tool	TRL before	TRL after	CBRN relevance	Toolbox integration level
Equipment & Systems				
Nexsense	8	9	C	3
HAZKEY	9	9	CBRN	1
Light Fieldable Laboratory	7	9	B	4
UAV with camera	TBD	8	Generic	4
Track & Trace D5.4	0	6	Generic	4
Software				
Simple Guidance Tool for Triage	5	7	CBRN	4
CBRN Analysis	9	9	CBRN	3
CBRN simulation & modelisation tool	4	7	CB	3
EFFECTS	9	9	C	4
ESTIMATOR	0	4	C	4
Injury models	2	3	C	3
CABIS	7-8	7-8	C	4
Health Service Simulator tool suite, D5.9, D5.13, D7.2	6	7	C	3
Web-based CBRN training kit	0	8	CBRN	2
Source tracking model	0	5	CBRN	2
Secured Mobile Communication Bubble	8	9	Generic	4
Simple Secured Track & Trace	7	8	Generic	4
3D modeling for better site analysis	6	8	Generic	3
Platform for shared situation awareness (SAT)	5	7	Generic	4

Tool	TRL before	TRL after	CBRN relevance	Toolbox integration level
Mobile observation network tool	6	7	Generic	4
Guidelines & Protocols				
Guidance for exercise design (based on CIE Toolkit)	NA	NA	C	2
PPE selection tool	5	5	CBRN	2
Waste Storage Guidelines D5.11	1	9	CBRN	2
Remediation Action Plan D5.12	1	9	CBRN	2
Evaluation Support Tools	8	9	Generic	2
Public-facing communication manual D8.11	1	9	CBRN	2
Expert-facing communication manual D8.12	1	9	CBRN	2
Communication manual for strategic leaders and policy makers D8.13	1	9	CBRN	2
Decontamination tool D5.7	1	9	CBRN	2
Exercise methodology D6.1	1	9	Generic	2
Reference Scenarios D2.2	1	9	CBRN	2
Resilience matrix D8.16	1	9	CBRN	2
Public information kit D5.19, D7.5	1	9	CBRN	2
Safe Room Protocol D5.5	1	9	CBRN	2
Residual Contamination Strategy D5.6	1	9	CBRN	2
Procurement Protocol D7.3	8	9	CBRN	2
Protocol for testing Protection Equipment & PPE usage	1	9	CBRN	2
Protocol for detection and identification of C&B agents	1	9	CB	2

3.2.4 Toolbox training components

An online tutorial in the proper use of the Toolbox proper has been written and enables the user to reach 'Toolbox proficiency' in just two days. For each of the PRACTICE tools a manual/user guide is provided. This is particularly helpful for the more complex modeling and simulation software as these programs often require detailed parameter input for accurate predictions. Elaborate instructions are also available for the piece of infrastructure developed in the project, the PRACTICE Light Fieldable Laboratory. Further information on tool application range and restrictions as well as on performance indicators can be found in the tool template that is completed by every tool supplier when integrating the tool in the Toolbox. These tool templates should also include an ethical impact assessment of the tool.

PRACTICE partners generated a number of guideline documents and recommendations. Together with the resilience matrix these are considered a valuable aid for the planning and preparedness phase. Particularly, the communication manuals for emergency responders and strategic leaders

can be used in training concerning public communication and engagement during a CBRN incident for emergency professionals across Europe.

Furthermore, specific capabilities allow for the use of the entire Toolbox in “training mode”. The reference scenarios and the scenarios from the live exercises and stakeholder workshops are stored in the Toolbox and can be recapitulated for training purposes or can guide exercise planning together with tools for exercise and evaluation methodology. New incidents can be created and handling of real events can be stored, thus extending the arsenal of training opportunities and supporting crisis management evaluation and ‘lessons learned’ through ‘after action review’.

Finally, CBRN experts and pedagogues jointly produced a basic CBRN training course that provides basic general knowledge on CBRN weapons of mass destruction and teaches scenario building, risk assessment and hazard management as well as more specialized knowledge about chemical, biological and radio-nuclear threat agents. This course also includes sections on environmental aspects of CBRN and on CBRN systems (dispersion modelling, decision support, automated warning and reporting) which apply the previous knowledge and assist in the various phases of CBRN crisis management.

3.3 Toolbox validation

3.3.1 Testing the concept and individual components

In order to validate the Toolbox concept the researchers analyzed one reference scenario for each letter, *i.e.* B1-Biological attack at airport, C1-Chemical attack inside building and R1- Radiological dispersal in city, using the operational functions defined earlier. This analysis resulted in flow charts covering different aspects of the situations in the different parts of the security cycle, and specific tools needed to handle the situation were identified. The concept of the Toolbox was validated in the sense that it was possible to construct meaningful flow charts from the operational functions for all of the scenarios tested, it was possible to connect the functions to necessary tools, and the information flow between the different Toolbox elements could be followed.

Complex modelling and simulation software as for example the Health Service Suite for planning and preparedness of the medical emergency response (including hospital care) was extensively tested and adjustments implemented in order to improve the performance.

Prior to the full scale field exercise in Poland (see below) the project team met to integrate all tools developed within the project at appropriate levels into the Toolbox and to assure proper functioning and communication between tools and Toolbox.

3.3.2 Desktop exercises

In connection with the three live exercises the project organized a number of stakeholder workshops at which the Toolbox was used to handle various scenarios. Workshop participants were split in various groups representing different crisis management functions, *e.g.* First Responders ‘on the ground’, crisis management headquarter, political leadership etc. These desktop exercises had a similar focus as the accompanying live exercise, *i.e.* communication between the functional groups through the Toolbox, Toolbox use for preparedness and during the actual response phase. All three simulations featured chemical scenarios oriented on reference scenarios, but these were of different

character: i) intentional release of a toxic chemical in the city hall, ii) contingency plan for a high risk chemical plant, and iii) hijacked chemical transport.

The feedback on Toolbox functions and user-friendliness received during these workshops was instrumental for further improvements.

3.3.3 Live validation exercises

Three live PRACTICE validation exercises were held in Birmingham, UK, August 2013; Umeå/Sandö, Sweden, March/May 2104; and Pionki, Poland, April 2014 to support evaluation of different aspects of the PRACTICE Toolbox. The exercises were means of integrating and validating, in real environments, the improved concept, equipment and procedures. The exercises covered different conditions and challenges related to CBRN and were conducted by actual end-users in an international composition. Their views represented a significant added value for project conclusions.

The first exercise featured an indoor scenario with the intentional release of a chemical substance (see reference scenario C1 in Table 1). In the context of First Responders' execution of critical functions in response to the event, the primary aim of the exercise was to evaluate the impact of using qualified crisis information to the public, as well as to advance the theoretical and practical understanding of public information needs, public behavioural responses and the underlying drivers

of these responses to CBRN events (see section 3.1.3 above). More than 40 “naïve” volunteers, i.e. without previous experience of CBRN incidents, and about 150 First Responders participated in this full day exercise and provided feedback in form of questionnaires, in interviews and group discussions. The data obtained was used to improve the initial versions of the three communication manuals and to update the resilience matrix. Another aim of the exercise was to provide a platform for preliminary testing of the first Toolbox version and integration possibilities for external tools. In addition, tools from PRACTICE partners and from external organisations were tested during the exercise.

This first exercise served as a template for methodology of organization and planning, and provided the ground for testing evaluation principles and to extract necessary templates and examples of implementation for the Evaluation Support Tool, which was refined afterwards and later integrated in the Toolbox.

Impressions from the first live exercise ARDEN in Birmingham, UK, in August 2013. Photos: HCFDC Services, West Midlands Police

The second exercise focused on the use of the Toolbox in CBRN training of First Responder personnel and was set up as a case study where two different groups independently performed two similar exercises, i.e. a radiological scenario with explosion of a dirty bomb on a town square, with a six week training period between the different occasions. The first training session was used to measure a performance baseline for each group and the second training session was used to measure improvement in performance after having used components from the PRACTICE Training Kit for home studies. The two groups of trainees were made up of either First Responder professionals from the local/ regional police, ambulance and rescue services or of students in these professions from three different universities; none of the trainees had specific training or experience in handling CBRN incidents.

The evaluation task for this exercise was a challenging one. It illustrated the problem of evaluating a joint EU concept, the PRACTICE operational functions, applied in a national and even

local/regional context. The approach was to map national procedures against the PRACTICE operational functions and to find answers to questions like “Which operational functions gained most by using the training material?” One could for example assume that some operational functions are more of structural nature while others are more sensitive to the level of training. One conclusion from the Swedish exercise was that such exercises must have a wider scope and include more societal ability resources in order to provide the wider context needed for the intended evaluation of operational functions. Another conclusion was that the PRACTICE Training Kit has potential, but that at least for home studies the training material should be provided in the native language. Trainees also expressed a need for more hands-on training in concrete crisis management operations.

Impressions from the Swedish exercise ARDEN, first part in Umeå, Sweden, in March 2014. Photos: European CBRNE Center

The third full scale field exercise was organised as an integral part of a large national exercise for Polish Fire & Rescue Services, with an overall international scenario including EU actors and officials. More than 400 rescue service staff participated. This exercise was the first occasion at which a fully functional Toolbox prototype with most tools integrated was used in the field. For the validation purposes of project PRACTICE four different CBRN scenarios were designed based on reference scenarios and played over two full days:

i) barrels with dangerous biological substances left in the forest,
ii) release of radionuclides in a laboratory fire,
iii) chlorine leak from a tanker transported by rail, and
iv) anthrax letters.

With the exception of a few recommendation and guideline tools, almost all tools developed in the project were used by the emergency services in at least one scenario. This way a large amount of relevant and valuable data was generated that subsequently was used to further improve tool integration and functionalities.

Impressions from the Polish exercise in Pionki, Poland, in April 2014. Photos: European CBRNE Center

Taken together, different aspects of the Toolbox have been evaluated by a variety of stakeholders in a set of six live and three desktop exercises, in total nine scenarios (five chemical, two biological and two radiological). These exercises were performed at four different locations in three European Member States. Some 1000 First Responders performed in the live exercises and another 500 participants were volunteers, researchers and observers coming from all over Europe.

While serving primarily various project-internal purposes, all three exercises were also a welcome training opportunity for the participating First Responders, which was further supported by an After Action Review provided by team members to representatives of the participating emergency response organizations.

3.3.4 Evaluation results

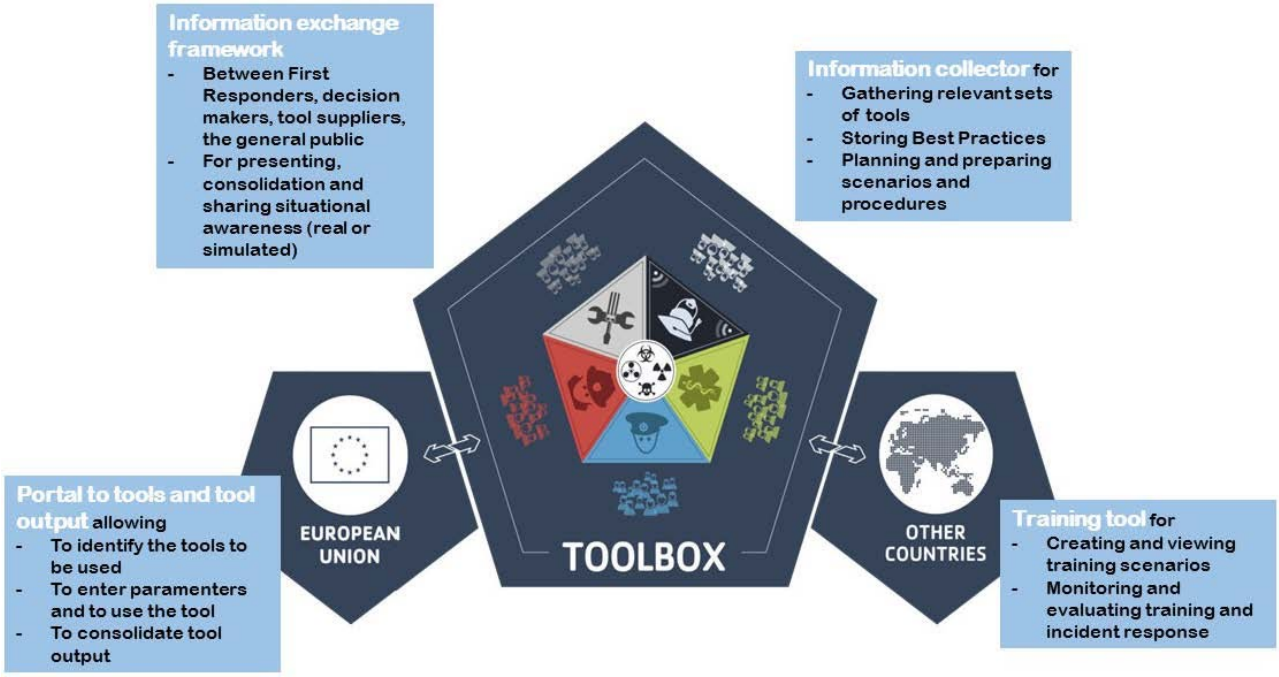
For the three live exercises evaluation data was collected in advance, during and after each exercise and included questionnaires, diagnostic tests, video-, GPS, and voice recording, observer protocols and debriefings. The evaluation process used a two level generic evaluation model with focus on measures of performance and measures of merit to enable analysing both tool performance and increase of societal ability. Collected data from the first exercise provided important insights into information needs by members of the public; emotional and behavioural responses to emergencies; as well as the drivers of public responses to CBRN incidents (see also above). These data helped

to shape and refine the resilience matrix and the three communication manuals. Given the useful data collected in the context of the first exercise, it is legitimate to state that exercises should become part of the methodological arsenal in social science research on CBRN incident management.

The second exercise showed that there appears to be a discrepancy between the expectations of the national First Responder personnel, i.e. practical training for their specific role in emergency response, and the PRACTICE concept of universally applicable operational functions, which are not bound by national characteristics and on which the PRACTICE training material was based. Consolidating these points of view is a challenge for future developments of an EU-wide CBRN training curriculum, but it is also a prerequisite for increased inter-sectorial and cross-border cooperation in crisis management. A first step towards consolidation of these two sides might be to combine the studies of theoretical knowledge with teacher-guided simulation and hands-on exercises. Adaptations of the operational functions to national standard operating procedures could be done in practical training sessions. The PRACTICE Toolbox has demonstrated its potential to support such combined training with the Basic CBRN Training Course, several documents and guidelines, scenarios, exercise guidance and simulation tools. The Basic CBRN Training Course per se provides the theoretical knowledge required for CBRN preparedness and response and can serve as an important body of reference for CBRN trainers or for First Responders studying to become CBRN specialists. Furthermore, in the light of the high costs for live exercises, in particular multi-agency exercises, the PRACTICE Toolbox used in 'training mode' can facilitate CBRN training at low costs.

For the last exercise the evaluation was based on the PRACTICE operational functions. A large group of observers representing a wide variety of perspectives and knowledge and spanning from professional First Responders to world-leading CBRN scientist assessed the Toolbox' potential to contribute to improved performance of these functions. For the majority of operational functions, the Toolbox was judged to contribute more to an increased societal ability to manage CBRN incidents than existing systems. This was especially the case for the operational headquarter and on-site management, while the contribution to EU headquarter functions appeared to be comparable to existing systems. However, in the area of care for the public, the assessment of Toolbox contributions was more positive even on the EU level. Thus, overall the Toolbox demonstrated a high potential to improve societal capabilities to manage CBRN incidents better than existing systems.

An overall conclusion from both, the Swedish and the Polish exercise, is that the list of operational functions serves as a valuable theoretical tool to evaluate and assess national level plans and resources rather than a tool to evaluate responses at the operative level.



4. Potential impact of the project

4.1 Stakeholder input

For a project like PRACTICE it was essential to capture and to answer to the needs of the intended end-users of the PRACTICE Toolbox. For this purpose a stakeholder platform was built up to which interested parties could subscribe for project updates and invitation to project events and which comprised of some 800 entries at the end of the project. The platform consists of First Responder and health care organizations (police, ambulance, hospitals, rescue services), national authorities involved in transport or in civil protection and crisis management, CBRN expert institutions, private sector/industry, societal groups and non-governmental organizations from all over Europe. Policy and decision makers on regional, national and EU level have for example participated in discussions on standardization issues in the CBRN domain, the impact of societal responses on CBRN incidents and implementation possibilities for the PRACTICE Toolbox.

As mentioned already throughout section 3 the project team has consulted stakeholder groups at various steps during Toolbox and tool development. Input to the project has been collected through workshops, surveys and person to person contact. Countries and organizations that have contributed to the scientific foundations of the project are represented in **Figure 7**. Stakeholders have provided input to the reference and the exercise scenarios, the identification of critical event parameters, definition of operational functions and connections between these. They have tested tools and the Toolbox concept as well as the Toolbox prototype. Their feedback on the concept, on tools and on Toolbox performance and capabilities as well as on the user interface helped to shape and to improve the prototype with all its facets.

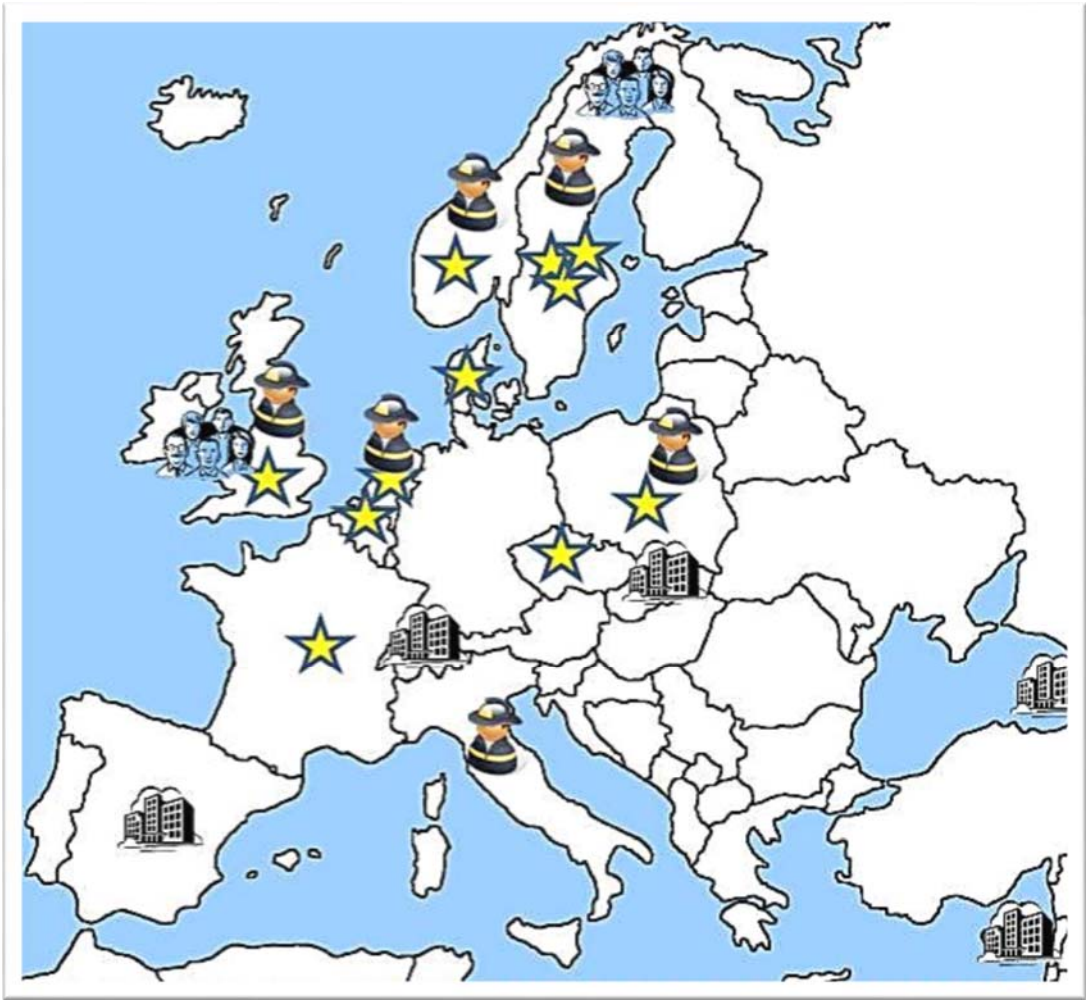


Figure 7: Geographical range of end-users that have contributed to the scientific foundations of project PRACTICE. Symbols represent end-user partners in the project (stars), First Responder and civil protection organisations, i.e. police, ambulance, rescue services (fireman), national forensic laboratories (buildings) and societal groups (group of people)

4.2 Dissemination activities

In order to ensure that the results from project PRACTICE have a lasting and permanent impact on European society project partners have undertaken significant efforts to make project results known and accessible to the European CBRN community. The project has launched a website with links to the stakeholder platform and the Toolbox (www.practice-fp7-security.eu). The project and its partners are presented, and publicly available project results can be downloaded. This website will be kept alive until three years after the end of the project, i.e. until October 2017.

The website provides access to the public part of the Toolbox with its CBRN-relevant information for the public. It is also the gateway to the Toolbox interface for registered end-users and tool suppliers.

Furthermore, the project has organized workshops of different character and purpose at which progress results were presented and discussed with invited stakeholders:

- 16 Aug 2013 - Stakeholder workshop following the first validation exercise (Birmingham/United Kingdom)
- 23 Jan 2014 – PRACTICE/BIO-PROTECT joint workshop (Paris/France)
- 24/25 Apr 2014 – Stakeholder workshop following the Full scale field validation exercise (Pionki/Poland)
- 6/7 May 2014 – Stakeholder workshop following the Training kit validation exercise (Sandö/Sweden)
- 22 Sep 2014 – Standardisation workshop, discussing PRACTICE outcomes for standardisation issues in the CBRN domain (Brussels/Belgium)
- 23 Sep 2014 – Final PRACTICE Conference (Brussels/Belgium)
- 24 Sep 2014 – European Security Round Table focusing on EU response capabilities and societal resilience to CBRN threats (Brussels/Belgium)

In addition to the events for the European CBRN community listed above, several workshops were held on a more national level in preparation of the three validation exercises in the United Kingdom, Sweden and Poland. Furthermore, PRACTICE partners have presented the project at various national and international conferences and EU policy meetings. Printed promotional material has been distributed and two videos have been produced to further advertise the project and the Toolbox. These materials are all available through the project website and will be used by partners even in the future.

The large number of exercise participants also fostered the dissemination efforts of the project team and helped to familiarize end users at different organisational levels with the Toolbox concept. Furthermore, good media coverage of the exercises spread the word about project PRACTICE and the importance of preparedness for CBRN incidents to a wider audience.

4.3 Business plan and exploitation of project results

After several iterations throughout the project, the Toolbox prototype delivers a repository of CBRN Tools and aims at becoming a “one-stop-shop” for CBRN Crisis Management. At this stage we have managed to deliver a capability that should rapidly evolve into a “must have” in particular for the European countries with limited experience in CBRN crisis. The new and improved tools developed within the project have proven their potential and benefit in operational scenarios. The end users praised the easy accessibility of the tools and their simple integration and cooperation, thanks to the Toolbox. The Toolbox allowed gathering both existing and background capabilities along with new or improved foreground developments.

Iterative development supported by the live exercises and workshops led to better usage and operation of the Toolbox and concrete recommendations for future developments. This approach was an effective way to implement an “evolving” concept while at the same time being concrete and useful. It also brought valuable feedback to be taken into account for the future. Basically it provided strong bases for the EDEN demonstration project: the PRACTICE achievements are the basis (EDEN V0) for the future and enhanced EDEN STORE federating the CBRN domain and leading to a single “one stop shop” for CBRN community (https://www.eden-security-fp7.eu/).

The Toolbox as developed through PRACTICE will be kept on-line as a reference. Specific information related to the project and not public will be removed for security reasons and reasons of

intellectual property rights, although the access to the Toolbox will be still secured. The tools referenced in the Toolbox, will nevertheless have their own life and no specific access to tools will be guaranteed through the maintained PRACTICE website. Consortium partners will be pushing the use of the Toolbox as test and validation Proof of Concept especially for exercise and training, gathering extra feedback and recommendations from specific end users. Further developments of the TRL 6 prototype will be done in the EU FP7 demonstration project EDEN (https://www.eden-security-fp7.eu/), building on these feedbacks and recommendations, especially credentials and links to tool providers will be introduced to consolidate the role of the Toolbox in the CBRN community and widen its use among users.

Further developments of PRACTICE tools as specified by partners in their individual business and exploitation plans will also offer opportunity to integrate the tools again in the follow-up EDEN STORE capitalizing on the PRACTICE developments and offering continuity. Putative customers of PRACTICE tools are welcome to contact the respective partner listed in the tools catalogue of the Toolbox.

Furthermore, as the training capability of the Toolbox has demonstrated its potential, it is foreseen that the respective owners of these products will further develop them for effective commercial exploitation.

Academic project partners and their PRACTICE research results had significant impact on the theoretical understanding of public responses to CBRN incident and improving the (practical management of) public responses to such incidents. Partners have successfully published their findings in scientific journals and media directed towards the civil protection community, and will continue to do so.

4.4 Societal implications

One of the main concerns of the EU CBRN market was its fragmentation, due to which the position of the European CBRN industry was relatively weak in the global arena. Therefore, one of the added values of PRACTICE is its potential to help solving this problem by uniting tool providers through the Toolbox, demonstrating the quality of integrated products and services, and gaining a more significant position on the global market for the European CBRN and security industry.

The Toolbox represents a significant improvement in societal resilience to CBRN events enhancing the inter-operability between different organizational set-ups and different national systems for CBRN incident management. The impact of the PRACTICE project and the improvements to the current situation it provides have been summarized in the table below.

Sector	Situation prior PRACTICE	PRACTICE achievements and contributions
Crisis Management	There is not one clear CBRN crisis management approach. Fragmentation leads to some functions to be doubled, while others are missing.	- The PRACTICE Toolbox represents one system that allows for implementation in any country, without large investments since it builds on and uses existing elements. - Countries will know what to do, and can choose elements from the Toolbox on how to do it.
International cooperation	Different national approaches are difficult to integrate for joint emergency responses. No clear counterparts (who is who?).	- Unified CBRN approach integrating existing and new capabilities. - The Toolbox allows countries to pick and combine different elements into one integrated approach that allows for easy international cooperation. - One of the outputs is a matrix of roles and functions facilitating integrated international cooperation.
Planning	No information system for CBRN capabilities.	- Online Toolbox Information system allows planners to plan according to the concept and pick those items they need.
Protection	No shelters in 'normal' buildings and urban areas.	- Guidelines for designing strategic safe rooms to protect people from toxic agents
Medical	Not all countries are able to handle mass casualties.	- Integration of mass casualties identification procedures and software with first response actions and medical treatment (tracing of victims, belongings and samples as well organizing available healthcare resources)
Sensors	Sensor data is not integrated in decision support software.	- Integrated sensors and detection systems, industry interface standard
Decon-tamination	No integrated decontamination system, only separate components.	- One concept integrating mass decontamination, decontamination of personal belongings and track and trace of victims; a concept that can integrate different national capabilities and technologies.
Training	Fragmented and expensive.	- The PRACTICE training kit for First Responders facilitates training using one EU concept. - Cost savings through the use of a virtual environment
Public	No preparation of the general public. Limited preparation of how to inform the public when a CBRN incident occurs.	- Website for informing and preparing the general public - Human behavior and risk communication manuals

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6. Consortium partners

Astri Polska Spolkaz Ograniczona Odpowiedzialnoscia	AstriPL
Airbus Defense and Space SAS (formerly Astrium S.A.S.)	AST
Airbus DS SAS (formerly Cassidian SAS)	EADS
Bruhn Newtech A/S	BNT
CBRNE Ltd	CBRNEltd
Comité Europeen De Normalisation	CEN
Forsvarets Forskninginstitutt	FFI
Haut Comité Francais pour la Defense Civile	HCFDC
King's College London	KCL
Mittuniversitetet	MIUN
National Center for Scientific Research "Demokritos"	NCSRD
Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek	TNO
Netherlands Forensic Institute	NFI
Prometech BV	PRO
Public Health England	PHE
Selex ES Ltd	SELEX
Selex ES SPA	SSI
Sodersjukhuset AB	SPC
Statni Ustav Jaderne, Chemicke A Biologicke Ochrany vvi	SUJCHBO
Szkola Glowna Sluzby Pozarniczej SGSP Poland	SGSP
Totalforsvarets Forskningsinstitut	FOI
Umea Universitet European CBRNE Center	UMU
Université Catholique De Louvain	UCL