ENCIRCLE
EuropeaN Cbrn Innovation for the maRket CLustEr

D4.4 ENCIRCLE Cluster Discussions Y4

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Executive Summary

The main goal of the ENCIRCLE Project is to strengthen the European industry to help create the tools and strategies needed to consolidate the EU CBRN communities of suppliers and practitioners in order to strengthen the field of CBRN safety, security and defence in the European Union.

The purpose of this Deliverable D4-4 is to summarise the discussion to date on the ENCIRCLE Project covering the period October 2019 to September 2020 and presents the latest information concerning:

- Innovation Developments

  • Status updates on the projects TERRIFFIC, EU-SENSE, COSMIC, SERSING and EU-RADION

  • Developments on the ENCIRCLE Catalogue which now contains 277tools

  • Developments on the ENCIRCLE innovation watch and CBRN needs and gaps

- Workshops and Events conducted by ENCIRCLE in year 4

- Market and Business support developments including an updated market analysis

- Integration and technical support concerning standards development and Human Factors

The consortium welcomes views and inputs concerning all the sustainability options discussed in the report including:

  • Creation of the new management board to manage the ENCIRCLE catalogue after August 2021

  • Transition of the ENCIRCLE Cluster into a new CBRN Thematic Working Group or experts group

  • Transition of ENCIRCLE resources to a new repository

Please contact the ENCIRCLE Co-ordinator and Technical co-ordinators directly with your inputs before the end of November 2020.

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1   Introduction

The main goal of the ENCIRCLE Project is to strengthen the European industry to help create the tools and strategies needed to consolidate the EU CBRN communities of suppliers and practitioners in order to strengthen the field of CBRN safety, security and defence in the European Union.

In order to achieve this goal an innovative approach based on five objectives aimed at prompting innovation, business development and filling market gaps in the Project timeframe was proposed. The Project objectives include:

- Create an open and neutral EU CBRN cluster,

- Provide a sustainable and flexible vision and roadmap for the development of the European CBRN market and innovations,

- Provide integration with platforms (systems, tools, services, products) by proposing standardised interfaces and future EU standards to integrate CBRN technologies and innovations developed from the Part b projects,

- Support CBRN safety, security and defence commercial and market services,

- Improve and facilitate European CBRN dissemination and exploitation.

The purpose of this document is to summarise the discussion to date on the ENCIRCLE Project covering the period October 2019 to September 2020

2   ENCIRCLE Discussions

The ENCIRCLE Project has been running since the 10th March 2017 and the following sections summarise the discussions that have occurred between the period October 2019 to September 2020.

2.1   INNOVATION PLAN AND DISSEMINATION

Part of the ENCIRCLE Project's objective is to improve EU resilience to CBRN threats and attacks. As such details of needs and gaps from previous CBRN related projects were gathered, assessed and collated to create a current view of what the CBRN community requires from industry to progress and improve response in the CBRN sphere. This in turn will foster innovation and lead to the creation of technologies that are genuinely required, and with the help of ENCIRCLE, those innovations will be successfully brought to market, creating a stronger EU presence in the CBRN marketplace. This produces the overall result of creating a focus on the areas which most need innovation and improving dissemination in such a way that it helps inform both the Commission and the industrial/academia/practitioner community when it comes to composing future Part b Calls and building the Consortia necessary to address those Calls. It is then incumbent upon ENCIRCLE to mentor, liaise and report on the resulting H2020 CBRN Projects which arise out of the winning Part b Consortia. To date there have been three such Projects let (stemming from the 2017 Part b Calls) which are now maturing into their second year, with most recently a further two Projects let as a result of the 2019 Part b Call round:

2.1.1   Part B Project Update TERRIFFIC

Background
The first hours of response to a CBRNe incident, and especially a radiological event, are particularly critical to contain the most severe consequences, stop the ongoing criminal/terrorist threat, save victims, manage the crime scene and organise an effective response by all concerned stakeholders – firefighters, health responders, forensics, police, decontamination units. They are also the riskiest moments for the first responders, as the nature, extent and intensity of the contamination is still unknown and other booby traps and contaminated objects may still be present.

The solutions provided by the TERRIFFIC project are tailored to the needs of practitioners and will allow for less human intervention in the operation, due to a higher number of automated processes and improved and extended mobile detection capabilities in the 'hot zone'.

Improved situational awareness and the delivery of near real-time data within the TERRIFFIC System will result in a better Common Operational Picture. This will enable the incident commander to gain a better comprehension of the nature of the threat and therefore make better-informed decisions.

Project Objectives
There are five key objectives of the TERRIFFIC project, which are:

Objective 1 Deepen the shared understanding between practitioners and (technological) solution providers on the needs/requirements during the "first hours" of response and technological possibilities and features matching them

Objective 2 Create the open architecture of the TERRIFFIC System, which promotes (future) integration of (existing) solutions and develop an innovative user interface enabling practitioners to easily deploy the system during immediate response

Objective 3 Adapt promising existing solutions from previous research initiatives, convert them into TERRIFFIC core components and integrate them into the TERRIFFIC System

Objective 4 Develop novel solutions on mobile sensing, measurement devices and dispersion models and integrate them as core components into the TERRIFFIC System

Objective 5 Successfully test the TERRIFFIC System and its core components under demanding lab conditions and within field trials to demonstrate the reduction of response time within the "first hours" of a RNe incident

TERRIFFIC: A step-change in first responder efficiency
The TERRIFFIC System consists of a set of complementary, interconnected and modular software and hardware components, which represent both novel developments of innovative technologies as well as enhancements and optimisations of existing solutions.

The TERRIFFIC System and its core components are highly mobile and will be able to be deployed quickly. The tactical incident management system installed on the mobile van will be initiated whilst en route. The van will also be equipped with easy to set up ground detectors for immediate deployment on-site, as well as having handheld detectors for use once the initial assessment of the risks has been completed.

Specialist UAVs, able to fly in rain and gusts of up to 90kph, with the world's smallest gamma cameras and new sensors attached can be operational within minutes and will be used to visualise and identify the location, size and type of the source. They will also be able to spot potential victims and communicate visual data about damage and people needing assistance.

UGVs with sensors and cameras can be sent in to obtain further data from closer up. The data that these sensors provide are used to create a plume modelling forecast, which will give a more accurate and dynamically updated determination of the contaminated area and the control area. The plume modelling algorithms have been specifically designed for use in complicated urban environments and take into account the wind, weather and surrounding buildings, which will all affect the spread of the radiation.

All of these tools send information into the Augmented Reality solution and into the incident management software concurrently. This greater knowledge results in a reduced risk profile and a higher level of safety for first responders.

It has never before been possible for a CBRNe incident commander to be able to access so much data in near real-time. The TERRIFFIC System has the potential to have a significant and genuine impact on how an RNe incident is managed by first responders and to save lives both of practitioners and members of the public.

Project Achievements to date
Bruhn NewTech
- Development of established incident management software that can accept and share data from various external tools and solutions, including detectors, sensors, cameras, plume modelling and mixed reality, providing improved situational awareness in a user-friendly format

École Centrale de Lyon
- Sensor that detects the location, type and size of a radiation source and plume modelling software that predicts how far and in which direction the plume will disperse in a complicated urban environment
- Successfully tested on the UGV from Nexter Robotics and UAV from AERACCESS

Luxembourg Institute of Science and Technology
- Innovative, bespoke CBRNe mixed reality solution, allowing 3D visualisation of the incident; data from the UAV or UGV-mounted sensors are fed into the software, which can also be used to draw on cordons or other key information
- Integrated into Bruhn NewTech's incident management software solution and is dynamically updated during the incident

The French Alternative Energies and Atomic Energy Commission (CEA)
- Development of the world's smallest Nanopix Gamma camera that weighs just 268g, which is important so it can be mounted onto UAVs and UGVs
- New hand-held Gamma detector that will be able to detect Beta contamination in a high Gamma background

AERACCESS
- Adaption of the Hawker Q800X, a ruggedised UAV, which can fly in higher winds (70kph with gusts up to 90kph), rain and other weather conditions, to take the Gamma camera and sensor as additional payloads and feed data back into the incident management system; successfully used in trials
- Smaller NanoHawk UAV flown in tests inside a building with a camera and located radiation source; larger drone used to relay comms to NanoHawk

Nexter Robotics
- Adaption of the Nerva XX UGV to take the Gamma camera and Gamma detector, providing more accurate data and imagery from inside the hot zone

ARKTIS Radiation Detectors
- Successful integration of the TERRIFFIC System inside the MODES mobile detector van
- High sensitivity SiPR Gamma detector developed and tested on UAV and UGV

Exploitation Update
A first draft of the project deliverable *D7.4 Exploitation Strategy and Business Plan* was submitted and approved at the beginning of June; the final version of the report is due in October 2020 (M30).

A dedicated Exploitation working group has been set up, which is exploring the most appropriate and most impactful ways to exploit the results of the TERRIFFIC project. Identified possible routes include being involved in further research, providing input to policy makers and the partners working closely together to add value to their existing customers by encouraging them to procure one or more of the TERRIFFIC components alongside the solution they already own. It is also feasible that this route could attract further external development funding in due course.

An independent CBRNe market analysis has been commissioned by TERRIFFIC and ENCIRCLE to research the overall market and to identify key trends and market opportunities. Two interim review sessions have been held and the final report will be delivered on 21st September. This key piece of

work will provide great assistance to the working group and individual partners and enable them to focus on the sectors with the greatest potential for exploitation.

The project partners are also working in parallel on their own exploitation plans. A dedicated session will be held during the General Assembly meeting on 21st September to discuss these, after which they will be incorporated into *D7.4 Exploitation Strategy and Business Plan*.

CONTACT INFORMATION

If you would like to know more about the TERRIFFIC project, please visit the project website at www.terriffic.eu or contact us by email:

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communication-terriffic@eurtd.eu

2.1.2   Part B Project Update EU-SENSE

Chemical Agents have been used in warfare against military personnel for almost two centuries, however, with increased terrorist activity in recent decades, the scope of defence effort has broadened to include the more significant threat posed to civilians. Both military and civil defence require fast and reliable methods for detecting agents at levels that pose a health risk for accurate assessment of severity and extent of hazard and efficient use of countermeasures. Civic defence resources, in addition, face the threat of industrial incidents resulting in dangerous contamination of environment.

The consortium composing the EU-SENSE project took on developing a novel network of sensors capable of detecting a large spectrum of chemical agents. The objectives of the project are primarily:

- To contribute to better situational awareness of the CBRNe practitioners through the development of a novel network of chemical sensors, which will provide a technological solution to relevant gaps presented in the ENCIRCLE catalogue of technologies.

- To improve the detection capabilities of the novel network of chemical sensors through the use of machine learning algorithms to reduce the impact of environmental noise and the application of contaminant dispersion models.

- To showcase the usability of the EU-SENSE network to CBRNe practitioners in order to validate the system and to maximize its exploitation potential. The objective also entails the preparation of training sessions with CBRNe practitioners in relevant conditions.

The main concept of the project is based on three layers. The first - the network layer - consists of heterogeneous sensor nodes that combine detecting capabilities of four different technologies: Proengin AP4C Flame Photometric Detector, Airsense IMS detector with integrated Electrochemical Cell, Airsense IMS Photon Ionisation Detector, and TNO SRD MetalOxide detector. Those sensors are integrated through the Network of Sensors Controller.

The computational layer is constructed in compliance with the system-of-system approach though the use of independent tools:

-   Source Location Estimation Tool – runs a dispersion engine to assess location and strength of the hazard's source.
-   Hazard Prediction Tool – performs dispersion calculation to predict the behaviour of the incident.
-   Environmental Noise Learning Tool – utilizes machine learning to minimize the false alarm rate.

The final layer is the situational awareness layer consisting of the main access point to the system through the user's perspective - the Situational Awareness Tool, with the graphical interface that renders visualisation and control functionalities – as well as integrated training module.

Figure 1 The four sensors of the EU-SENSE sensor node. Source: EU-SENSE

The project is currently in advanced stage of development. The recent months concluded work on the second iteration of the sensor node. Finished hardware was also tested in an integration session with the sensors. The design and development are progressing for the Hazard Prediction Tool and the Source Location Estimation Tool, as well as Situational Awareness Tool. The consortium partners are currently working on improving the computational tools and integrating them with the developing Graphical User Interface.

Despite the immediate impact of the pandemic outbreak on the project, there was a significant impact on progress on the dissemination efforts within the project. The main affected area was the field measurements necessary for the machine learning progress in the Environmental Noise Learning Tool. The planned conferences and publications, however, were made possible through the effort of their respective organisations, like the International Society for Optics and Photonics, organisers of SPIE Defence + Commercial Sensing, where ITTI presented the project, as well as published extensive paper on the systems architecture and ambition.

If you would like to know more about the EU-SENSE project, please visit the project website at https://eu-sense.eu/

2.1.3 Part B Project Update COSMIC

2.1.3.1 Objectives and concept of the project COSMIC

Modern customs deal daily with tenths of thousands of containers, potentially containing CBRN threats. They currently open some containers for inspecting them, sometimes basing on the manifest of the cargo and some additional knowledge from the custom administrations. H2020 Profile project (https://www.profile-project.eu/) is currently working on the automatic analysis and incorporation of data from different sources, resulting in an improved selection of the containers to inspect.
But even with this automatic profiling of the cargos there are still several challenges to face:
- Manual inspection of the containers remains very expensive in terms of both of devoted resources and consumed time
- Smugglers and terrorist may still succeed in hiding their threating content in the cargo

Hence, it is necessary to equip the custom offices with technologies to detect the threats more effectively and an inspection mechanism that is much more cost effective than the current one. Accordingly, COSMIC consortium has rethought from scratch the whole operation in customs and proposes the following process of containers in the customs as a three phases procedure:
- At any time, the custom operator may decide to take any container directly for manual inspection;
- In a first phase, custom operators will run a first screening of each container with low-cost sensors with average precision and fast response times to detect if there is any potential threat of the main types (explosive, chemical and radiological). From this, the many containers that do not trigger any alarm are released with very little cost;
- In a second phase, containers that triggered an alarm proceed to a second row (letting the rest of containers to continue its process) and are screened with more accurate sensors, at the cost of being more expensive and taking more time to perform their calculus, but as they are applied only to the second row, they will not cause any significant delay in the processing of the whole processing chain. If the sensors of the second phase detect any threat, the container proceeds to the third phase for manual inspection; and
- In a manual inspection phase, the containers will be opened to physically locate and isolate the threat, and to further clarify the nature of the threat in the case of biological threats.

However, detecting threats from sensors still have the following challenges:
- X-ray is limited in its capabilities
- Radiation detection results of RN threat material is matrix dependent
- Shielding / masking is seen across the organic-inorganic-metal material spectrum

Additionally, there is no 100% accurate sensor, especially because the attackers will do their best to hide the threatening materials from them. Thus, sensors normally produce detection probabilities, using probability thresholds for triggering the alarms. Besides collecting the measures taken from the sensors in each phase, COSMIC combines those measures with the manifests to execute automatically the profiling that was performed manually by the customs authorities, refining the probability obtained from sensors while still using the knowledge of the customs authorities.
This optimized process requires a graphical tool to let customs operators follow the whole process and assess the risk for each container. COSMIC has developed an advanced and user-friendly graphical tool

that allows customs operators to easily follow the progress of each container, its measurements, possible threats detected and evolution through the process.

2.1.3.2   Progress up to date

2.1.3.2.1   Data sensing capabilities

Explosives detection

An explosive detector from SEADM, which has included the following upgrades:
- High Voltage System Redesign
- Cold Trap Redesign: New cold trap materials and new cold trap heating system.
- Additional improvements in flow control and measurement added.
- Additional functionality in monitoring and control SW has been developed.

Nuclear and Radiological (NR) detection

For the primary phase, NR detection relies on an already existing device, the RPM (Radiation Portal Monitor) and High Energy X-Ray.
For the secondary phase, the X-Ray image will be analyzed for High Z objects or High density alarm, producing alarms inspected by the muon scanner, generating a 3d matrix of the sensed densities, which will be displayed later in the graphical tool for the users.
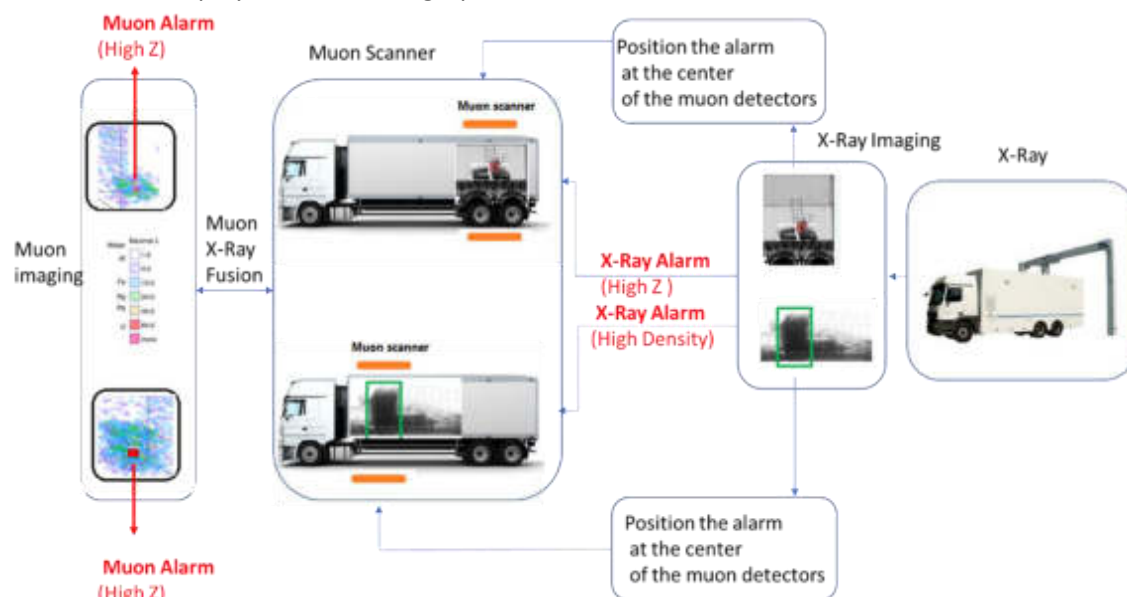

Figure 2: RN Detection using muon scanned. SOURCE COSMIC

Biological detection

COSMIC project, in collaboration with Yale University, has provided an improved DMA labelled provisionally as "PerezDMA". The project has addressed some issues from previous versions and implemented solutions, improving the resolution of the instrument achieving a resolution of 4,37% (22,9) using the Israeli Acute Paralysis Virus (25 nm) as the following figure represents. This improved resolution compared to typical instrumentation (GEMMA) also allowed the study of different

techniques of sample preparation. An iteration process of 3 steps of dialization provided the maximum reduction of background signal.
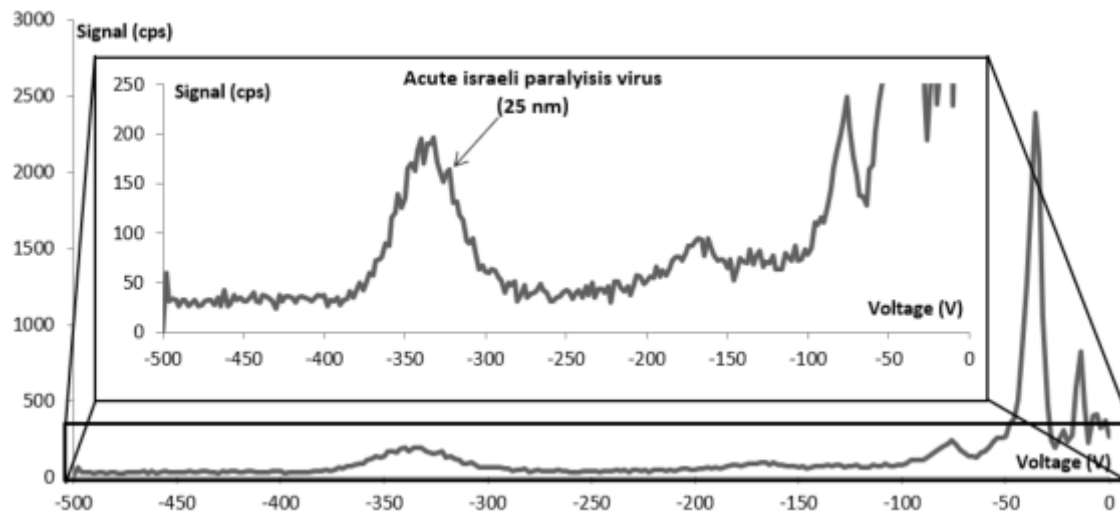

Figure 3 - Detection of the Acute Israeli paralysis virus with the increased resolution and 3 step iteration of dialysis. SOURCE COSMIC

The consortium has developed a new version of the instrument with improved resolution (~50, which improves the ability of the instrument to discern a virus from another of similar size) and size range increased up to 120 nm. It is capable to analyze the SARS-CoV-2 (100nm), allowing to further improve the current sample preparation techniques due to its unparalleled resolution and also can act as a standalone detector capable of precisely discerning the presence of the virus particles.

2.1.3.2.2   Graphical tool for the users

COSMIC provides a graphical tool that allows to easily perform the following operations:
- Access the summary of the manifest of each cargo for evaluating the risk of each container
- Graphically access the progress of each container in the system and the alarms produced in them including:
  - Current stage that the container is passing through
  - Icons that graphically depict the status for each kind of threat
  - Detail of all measurements taken for each container
- Manually input in the system the data for those sensors that due to their low-cost conception are not meant to send their data electronically to the system

Figure 4: Screenshots of the COSMIC graphical tool (SOURCE COSMIC)

2.1.3.3   Benefits for the practitioners

Now practitioners can open those containers that trigger an alarm from the sensors jointly with their profile and devote their scarce resources to inspect only the most dangerous containers, resulting in an improvement in the smooth continuity of the release of containers from the customs. As suspect containers pass to different phases, letting the customs to continue the processing of the vast majority of containers, the new procedure should significantly contribute to avoid the congestion of the customs operation resulting from opening many suspicious containers.

2.1.3.4   Exploitation

Exploitation plans from the project and especially from the partners are constrained and for that reason cannot be published. However, some things can be revealed because they are public, such as:

- Industry partners have already contacted specific custom business lines to start marketing and promotion activities, resulting in contacts with several customs administrations in the European Union
- Active attendance to networking events, such as SRE-event 2019 (https://www.sre2019.eu/) or info-days to prospect potential stakeholders
- Active collaboration with the ENCIRCLE project to gain visibility both among the research community and the potential customers.
- Inclusion in several solution databases related with CBRN detection in customs, including:
  - ENCIRCLE Catalogue of CBRNE solutions (http://encircle-cbrn.eu/catalogue/)

     o   PEN-CP catalogue of customs solutions (https://www.pen-cp.net/)

If you would like to know more about the COSMIC project, please visit the project website at https://www.cosmic-cbrne.eu/

2.1.4   2019 Part B Call Projects

2.1.4.1   SERSING

Despite sustained efforts over the past decade or more, there has yet to be developed effective instrumentation for detecting and guiding responses to CBRN threats in public spaces. The SERSING (Exploiting Surface Enhanced Raman Spectroscopy (SERS) and Advanced Algorithms for Guiding Responses to Potential Chemical Threats) project entails the development of novel handheld or robot-mounted instrumentation for near-real-time or on-demand detection/identification of chemical threats coupled with advanced algorithms to aid responders and incident commanders in hazard assessment and decision-making. The SERSing concept is illustrated below. The handheld Raman spectrometer is equipped with surface enhanced Raman spectroscopy (SERS) add-ons that enable detection of chemical threats in gas and/or liquid phase. A more complex sample pre-treatment and identification of hazardous substances can also be performed on-site using e.g. disposable centrifugal microfluidic disc add-ons. The Raman-SERS devices can potentially be mounted on a robot for remote sampling and detection. The measurement results are then reported to an incident commander and displayed on a threat map
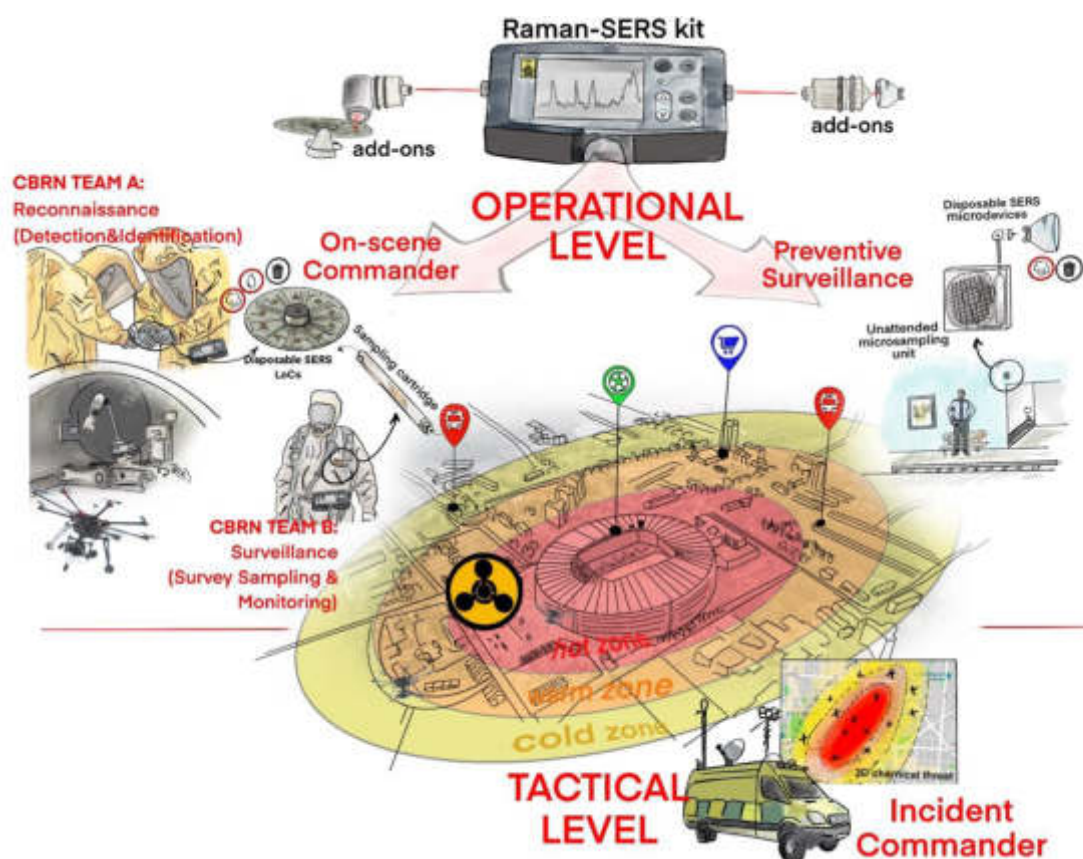
Figure 5 SERSING Concept: SOURCE SERSING

The SERSing project involves a team of four leading European academic groups, two high-tech companies (SME) with demonstrated expertise in advanced sensing and lab-on-chip (LoC) technologies, as well as two stakeholders (end users) responsible for CBRN and civil protection.

The vision and the overall goal of the project encompass a novel class of robust, lightweight, miniaturized, simple to use and cost-effective "plug and play" microfluidic surface enhanced Raman spectroscopy (SERS) platforms, which upon interrogation by an adapted handheld Raman spectrometer are able to provide a timely comprehensive picture of chemical hazards at the incident scene to improve real time situation awareness and decision-making (Figure 1). Gas and liquid samples are collected and delivered to the microfluidic platforms on demand or by a triggering signal; SERS analysis is performed and chemicals identified rapidly; and results are fed into a remote monitoring station equipped with fusion algorithms that provides options for response/action, if necessary. We have coined the term "SERSing" to represent this new SERS based approach (**S**ensing, **E**valuating, **R**esponding, **S**ecur**ing**).

The main objective of the SERSing project is to develop and validate "on field" for relevant chemical threats, i.e. chemical warfare agents (CWAs) and toxic industrial chemicals (TICs). The Raman-SERS Kit will be comprised of ultrasensitive SERS LoCs configured as ready to use "add-ons" for gas and liquid sampling and detection and a customized Raman instrument equipped with geo-location and communication technologies for the rapid screening of the incident scene. The Raman-SERs kit is conceived to overcome the common operational limitations of first responders, compatible with Personnel Protective Equipment PPE and respirators, easy to use and maintain with low cost of consumables. Thus, SERSing gives response to some of the existing capability gaps and specific needs

already identified by ENCIRCLE[1] (European CBRN Innovation for the Market Cluster project, co-funded by the European Union's Horizon 2020 work program under grant agreement No. 740450, topic SEC-05-2016-CBRN cluster: Part a) and IFAFRI [2] (International Forum to Advance First Responder Innovation) in the domain of chemical threats.

The 2017 EU CBRN Action Plans to enhance preparedness against CBRN security risks (COM(2017) 610) and support the protection of public spaces (COM(2017) 612) emphasizes the need to strengthen Chemical Security with a focus on preparing for, and responding to chemical incidents and terrorism attacks. The tactical importance arises from shorter response times, shorter on-site assessment times, and faster recovery and restoration times. Research and innovation is essential to keeping up with evolving security needs.

According to the International Forum to Advance First Responder Innovation (IFAFRI), first responders need technologically advanced tools and equipment that are affordable and innovative to rapidly identify, detect and analyse threats and hazards. These solutions may also include subsequent software or devices enabled to display data and analysis on an intuitive user interface. In order to improve responder safety, efficiency and effectiveness, responders need the ability to i) rapidly identify hazardous agents and contaminants; ii) understand pertinent information regarding protective actions or treatments for these threats to improve response situational awareness at incident scenes and decision-making.

The commonly used cumbersome chemical detectors are mostly based on ion mobility/mass spectrometry techniques and their acquisition prices start from 30.000$ excluding data libraries. More specific detection based on immunoassay techniques does not cover the full spectra of evolving chemical threats. Miniaturized sensors are gaining of importance but efforts on multisensor integration and analyses are still required to provide with reliable measurements.

The successful project yields a rugged, easy-to-use, handheld Raman-SERS kit that can be operated by first responders wearing personal protective equipment, mounted on a robot/drone, or emplaced at a network of fixed locations. The instrument(s) can provide fast, trace-level detection and unequivocal identification of a wide range of chemical threats in air or liquid media encountered in real-world environments. The geo-located data are transmitted to a smart, on-line platform for rapid processing, and the information derived from the data is immediately accessible to authorized personnel for decision-making and response actions/alerts. The pre-operational validation of the prototypes by means on field exercises is also addressed to provide input for the iterative and continuous upgrading of the SERSing technologies. Commercialization is facilitated by involvement of SMEs and end-users throughout the development, implementation and outreach phases of the project.

The project is coordinated by Dr. Tomas Rindzevicius of Silmeco ApS, in collaboration with 8 partners across Spain, The Netherlands, Denmark, Sweden, and the Czech Republic. Partners include:
Technical University of Denmark, University of Zaragoza, University of Vigo, University of Twente, Serstech AB, Swedish Defence Research Agency (FOI), The National Institute for Nuclear, Chemical and Biological Protection (SÚJCHBO).

2.1.4.2   EU-RADION

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[1] ENCIRCLE project (co-funded by the European Union's Horizon 2020 work program under grant agreement No. 740450, topic SEC-05-2016-CBRN cluster: Part a). Accessed on June´19: https://www.encircle.eu/

[2] The International Forum to Advance First Responder Innovation. Capability Gap 3 "Deep Dive" Analysis Synopsis. September 2017. Accessed on June´19: https://www.dhs.gov/publication/st-frg-international-forum-capability-gap-3-deep-dive-analysis-synopsis.

The EU-RADION project is a joint operation of 8 European institutions with varied fields of operation ranging from research facilities, through academic entities, to governmental bodies. The members of the consortium are focused on developing a novel system for CBRN threat detection and elimination that is set out to significantly improve the capabilities and safety of the first responders and emergency response teams.

The development process reaps the benefits of not only a wide range of experience and knowledge of the consortium members, but also from a close cooperation with potential end-users voicing their needs and suggestions during multiple workshops and consultation sessions throughout the duration of the project to ensure an impactful finished product with a real application.

The project is focused on designing and developing a fully operational system for detection and identification of RN materials with the added value of improved situational awareness and safety of the on-site personnel and dispatch teams. At the conceptual stage, the members of the project consortium have established the following High-Level Objectives to serve as a reference point for the work carried out under the project:

High-level objective 1 - To cover selected capability gaps of European first responders and CBRNe practitioners indicated in ENCIRCLE catalogue and IFAFRI study by development of relevant technologies,

High-level objective 2 - To enhance situational awareness of first responders/CBRNe practitioners during preparedness and response missions,

High-level objective 3 - To boost European CBRNe market innovativeness and support its competitiveness,

High-level objective 4 - To showcase the operational EU-RADION solution to first responders, CBRNe practitioners and European stakeholders in relevant conditions.

In order to achieve that, the EU-RADION consortium is focusing its efforts on providing both hardware and software solutions tailored to preparedness and response actions of practitioners in the RN domain.

The main components of the system in terms of hardware are as follows:

   a) **Sensor Integration Unit** (SIU) – A modular device supporting wireless connection and comprising 3 sensors (Geiger counter, Cadmium Zinc Telluride (CZT) detector, gas sensor) allowing the SIU to identify the agent and the radiation dose rate. Each unit is adapted to both stationary and mobile (person-worn or mounted on unmanned ground vehicles called UGVs) operation, which allows to create a tight-knit network able to monitor any given area thoroughly and reliably. As a result of a consultation with the potential-end users, each unit will be powered by a non-proprietary, easily replaceable power source, which can be replaced with off-the-shelf batteries.

   b) **UGV Swarm** – A novel solution in terms of situational awareness in a form of three unmanned ground vehicles of which 1 is controlled remotely by a qualified operator and 2 are moving autonomously in relation to the remotely controlled one and constantly adjusting their movement in order to scan a larger area in a much shorter time. Each UGV will be equipped with an SIU and a navigation unit with a positioning module, which would allow for unmanned probing of the environment, which is especially useful when there is a suspicion of high radiation dose rates in the area of interest (AOI)/ incident zone.

   c) **Navigation Unit** – A tracking module that is based on both inertial and GNSS sensors developed to allow for determining precise location and navigation of the on-site personnel and EU-RADION assets. A tool that will significantly increase the real capabilities of dispatch teams and operators directly translating to improved efficiency and safety of the operation.

D4-4 ENCIRCLE Cluster Discussions   18

In terms of software, the main components are:

a) **Unified Data Model** – Developed on the solutions from the EU-SENSE project in order to provide interoperability and scalability of the network system. The proposed standard is based on XML files allowing for network configuration flexibility and is necessary for the initial setup of the entire network.

b) **Tactical Command Tool (TCT)** - The highest layer of the system serving as an intuitive user interface and integrating data from measurement and computational components. It will display a map display of the area of interest with georeferenced information of the system components, estimated hazard and source areas, offer means of commanding of the system elements along with a display of their technical status.

c) **Dispersion Modelling** – A novel technological solution able to handle complex geometry along with particle-inherent properties (density, spatial dimensions, static forces) in order to perform deposition simulations beyond standard modelling tools. It will allow for improved source estimation by application of adjoint dispersion models and the method of regularisation, with adaptation of parameter selection methods not yet used in these type of applications, e.g. Unbiased Predictive Risk Estimation, Generalised Cross-Validation and Discrepancy Principle.

The successful development of the abovementioned solutions will directly translate to a significant improvement in terms of not only effective and time-efficient operation of dispatch teams and emergency management bodies, but more importantly, it will result in providing much safer working conditions for the first responders and on-site personnel.

Implementation of the EU-RADION's results will allow for a more thorough monitoring of the area of interest. The process of detection and identification of dangerous CBRN materials will be performed with the use of the following sensors:
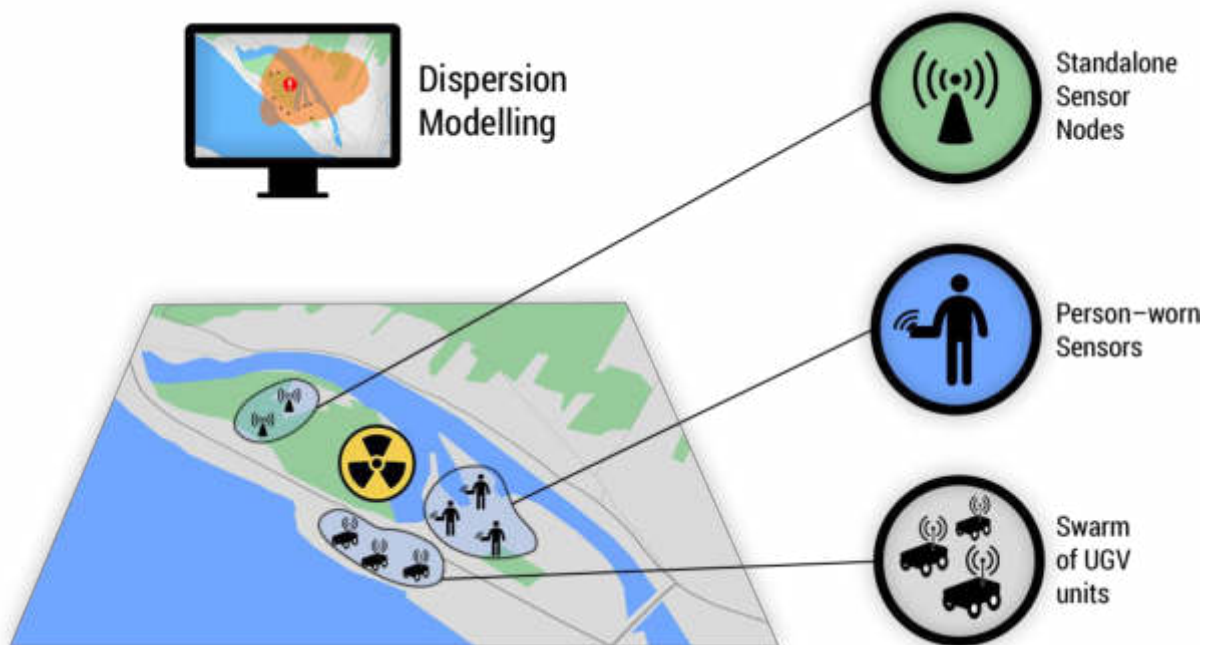

Figure 6 Detection and Identification - SOURCE EU-RADION

a) **Stationary**:
- Cadmium Zinc Telluride and gas sensors supported by a Geiger counter
- Implemented positioning module
- Non-proprietary battery or AC power supply (depending on available infrastructure)

- Wireless communication (processed data are displayed in the TCT)
b) **Person-worn**:
  - Cadmium Zinc Telluride and gas sensors supported by a Geiger counter
  - Implemented positioning module
  - Non-proprietary battery
  - Dedicated User Interface and display
  - Wireless communication (processed data are displayed in the TCT)
  - Generates alerts when close to detected hazards (based on threat map in TCT)
  - Mobile collection of data
c) **UGV-mounted**:
  - Cadmium Zinc Telluride and gas sensors supported by a Geiger counter
  - Implemented positioning module
  - Non-proprietary battery
  - Wireless communication (processed data are displayed in the TCT)
  - Mobile collection of data

Using a combination of the abovementioned sensors will allow to paint a full picture of the area of interest and, with the use of the Dispersion Modelling software developed in the project, determine the exact area of the threat as well as its source and type. Moreover, this three-way approach provides more safety to the on-site personnel either by alarming them directly of the proximity of the threat (alerts on the person-worn sensors) or by keeping them away from the threat by sending the UGV swarm to monitor the area instead.

With a unique combination of multiple detection technologies, various sensor applications, and novel software, the EU-RADION system is bound to revolutionise the CBRN threat detection market and significantly improve the safety and efficiency of the emergency operators.

2.1.5   2020 Part B Call Topics

This list of requirements was presented and agreed with the European Commission for publication under the Part B 2020 call topics, as referred to in the SEC-05-DRS-2019-2020: Chemical, biological, radiological and nuclear cluster topic description. This provided the basis for preparing the research and innovation actions (RIA) aimed at research and development of novel CBRN technologies and innovation, leading to solutions for the gaps identified in the ENCIRCLE dynamic catalogue.

2.1.6   ENCIRCLE Project Site

The ENCIRCLE website has been developed as a place for sharing information regarding the results of ENCIRCLE project, the activities of the ENCIRCLE consortium as well as supporting CBRN cluster Part B projects. The ENCIRCLE website serves also as one of the measures to communicate with the CBRN community by posting there links to ENCIRCLE surveys and questionnaires.

On the ENCIRCLE website one can find also publicly available information regarding the CBRNe field, such as information about calls, events, projects, companies, related institutions, and scientific and professional knowledge as well as EU regulations in this field.

On the ENCIRCLE website we promote also the Part b CBRN projects, which have dedicated pages with more detailed information and a list of over 300 EU funded CBRNe projects.

The ENCIRCLE project site has been continued to be updated and can be found here: http://encircle-

cbrn.eu/

Figure 7 ENCIRCLE Project Site

2.1.7   Dynamic Catalogue

Operational since June 2017, the ENCIRCLE catalogue has published 277 tools and has identified 302 gaps and 347 needs as of August 2020.
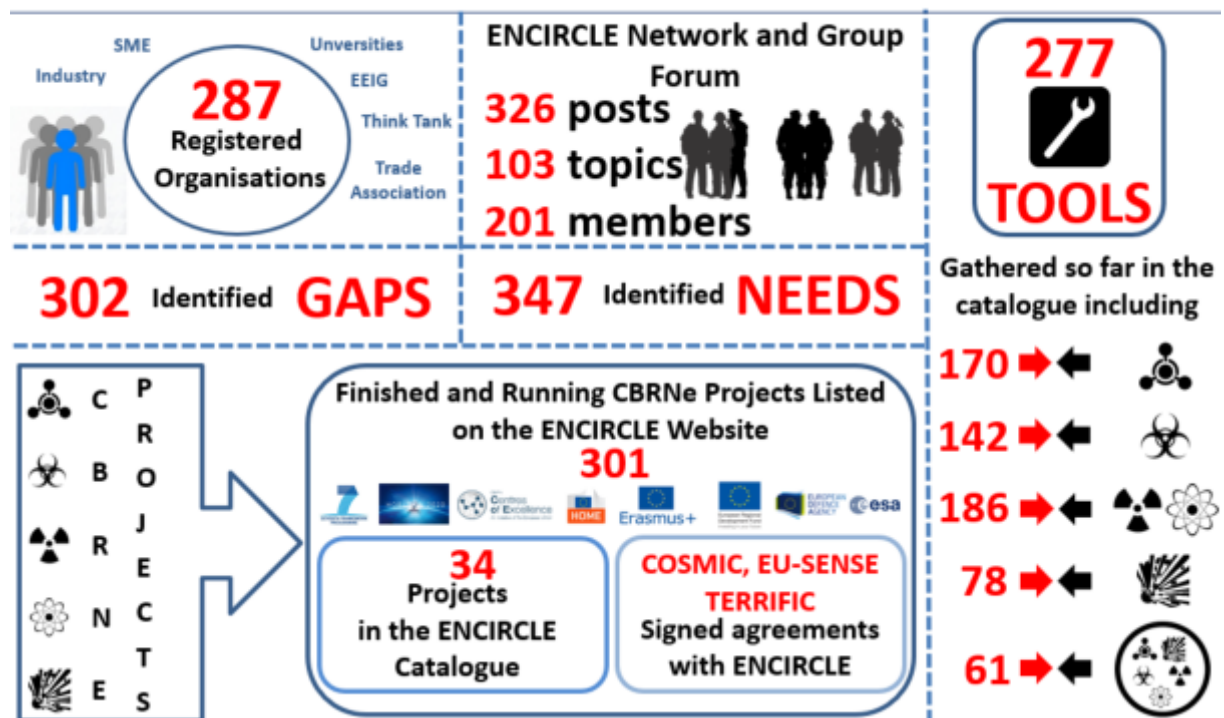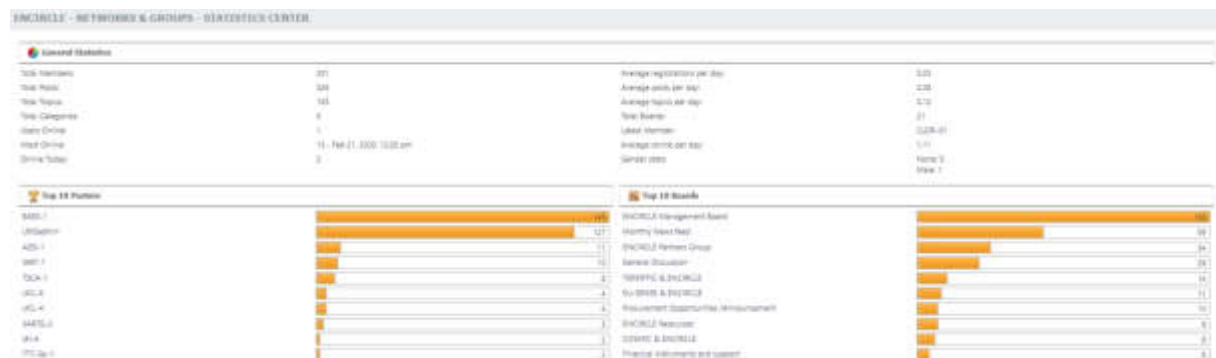
**Figure 8 ENCIRCLE Dynamic Catalogue Status**

The ENCIRCLE Network and Groups forum activities statistics are summarized below.

Figure 9 ENCIRCLE Networks and Groups Statistics

In the Network and Groups function of the Catalogue, a new section category "ENCIRCLE Resources" was created to house the ENCIRCLE project resources which will be useful for the communities. Currently, the uploaded resources include reports on First Market Analysis, Human factors analysis, Business Maturity Model and Best Practices.

In 2019 November, the Market Place is launched on the ENCIRCLE Dynamic Catalogue. The aim of the marketplace is to facilitate the direct interaction between the practitioner and tool provider communities, allowing them to obtain relevant information based on their search requests. For example, the user can search for tools related to any keyword where the search results give the lists of tools and projects related to the search keyword in its description and title. And together with these lists of tools and projects, a list of contacts that is associated with the tools and projects in the search results is also be displayed. For the practitioners, these results provide them the list of available services and solutions they are looking for and their respective point of contacts. For the tool providers, these results will give them an overall outlook on the available tools and services for specific domains, where it will be helpful for the planning of their research development direction. For the research community, they will be able to gain an insight of the available projects on specific domains and their respective point of contact information. Also, they will be able to get in contact with the tools and services providers that are relevant for their calls for future projects.

Below is a screenshot of the Market Place interface in the ENCIRCLE Dynamic Catalogue.
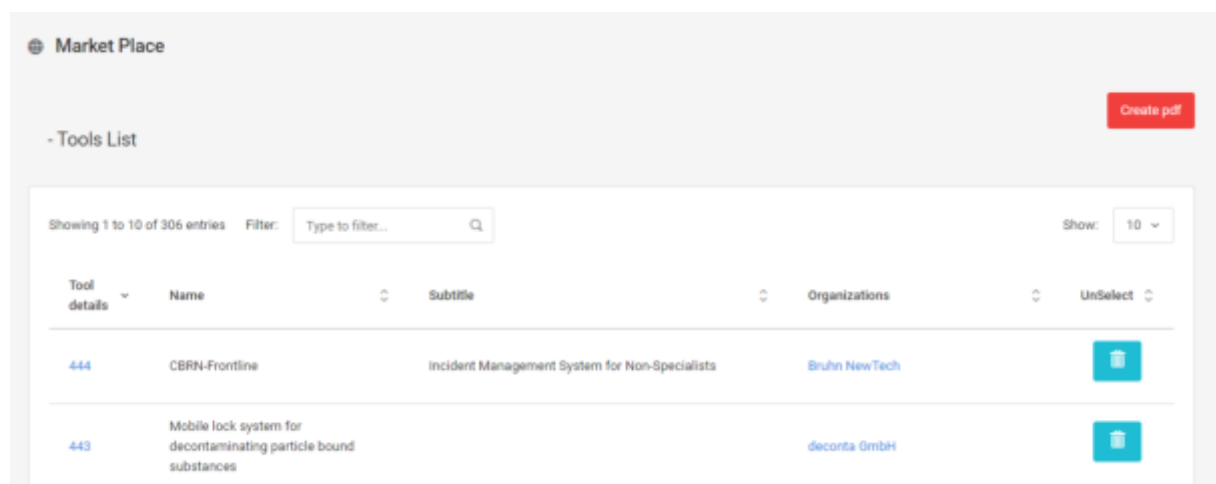
Figure 10 ENCIRCLE Market Place

The queried results are displayed in 3 separate tables: Tools List, Projects List and Contacts List.

In the Market Place, the user can search for tools related to any keyword. The search results will give the list of tools which contains the search keyword in its description and title. And together with the list of tools, the Market Place will also display the list of projects which contains the search keyword in its title and description, and a list of contacts that is associated with the tools and projects in the search results. In addition, the user can refine the search results by removing any lines of the results through the clicking of the blue button located at the right of each result item.

To save the search, the user can generate them in PDF formats by clicking on the red button located at the top right (above the 'Tool List') and bottom right (below the 'Contact List'). The resultant PDFs of the search results are shown below.

Figure 11 ENCIRCLE Market Place Outputs

Another function that was launched in 2019 was the Innovation Watch. In the Innovation Watch, the catalogue users can obtain relevant reports on CBRN that are collected, vetted and posted by the ENCIRCLE consortium. In June 2020, 2 widgets, developed by EU-VRi, was added to the Innovation Watch section of the catalogue:

- "Innovation Watch" widget, which presents potential interesting novel innovations,
- "Radar" widget that provides a pre-analysis of on-goings in the field of CBRN.
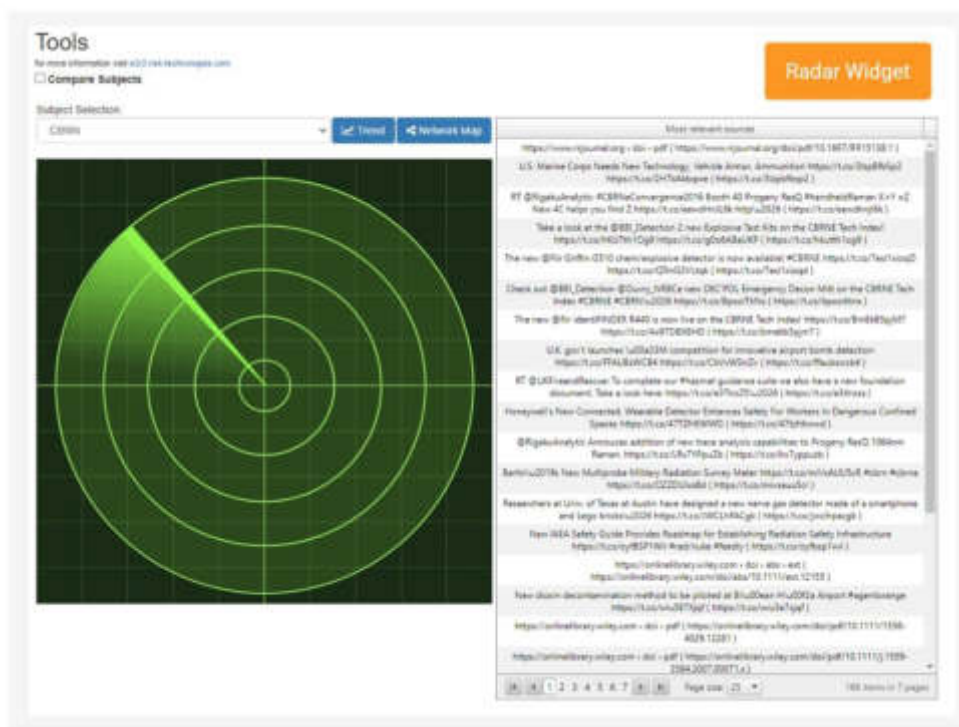
Figure 12 ENCIRCLE Innovation Radar

In these widgets, the user can obtain the web links to the relevant articles and reports (include twitter tweets, journal reports and news articles). The users are can also access all the collated articles in the form of a network map, which groups the articles into categories that includes Detector, Equipment, Repair, Training, Tool, Vehicle and Wear. This will be further elaborated in the following section.

2.1.8   Innovation Watch

The Innovation watch tool has continued to be evolved and improved during the project. The tool comprises a CBRN Innovation Watch and the CBRN Innovation Radar web semantics analysis tool. Both tools are based on the same 3-step approach:

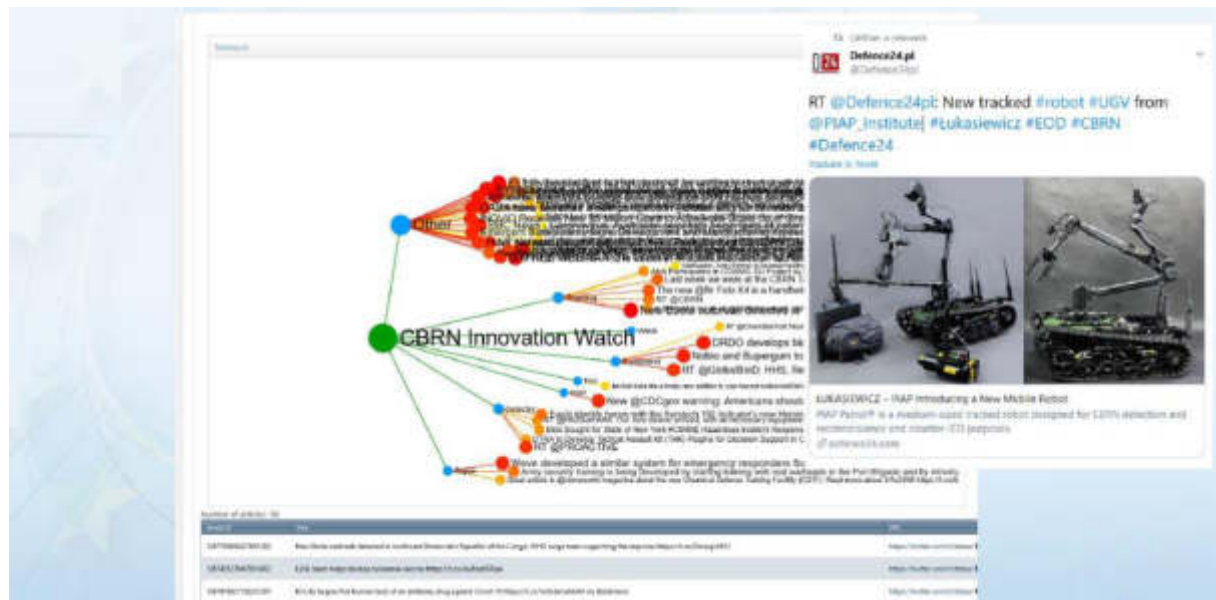- Step 1: Identify and monitor novel online content for a certain topic

- o Specify the search query that defines the topic of interest which can be narrowed or broadened using Boolean combinations

- o Every month, the tools retrieve and store relevant contents based on the users query

- Step 2: Identify potential high impact

  - o Evaluating the retrieved online content to identify those texts and documents that have the highest potential for impact with using an unsupervised quantitative big data analysis

- Step 3: Visualise recommendations

  - o Provides recommendations for new innovations to be included in the ENCIRCLE catalogue by identifying those topics within the high-impact documents that have the highest novelty value

An example of an output is shown below

Figure 13 ENCIRCLE Innovation Watch Output

2.1.9   Needs and Gaps

The list of 9 topics for the last CBRN Cluster call in the H2020 Framework programme, SU-DRS04-2020 CBRN Cluster was finalised in February 2020. At the beginning of March 2020, this list was under the final review by the European Commission. Final list was published on March 12, 2020 together with the call opening.

We continue to update list of CBRN projects carried out within various European programmes (EC, EDA, ESA etc.) and other programmes (NATO, national), which at the moment is over 300. The titles and some additional information about all identified projects have been listed on ENCIRCLE website. This list of the project and information about them will be used in the final review of the needs and gaps and preparation of the ENCIRCLE innovation roadmap.

The work on analysis of all needs and gaps that were gathered in EDEN and other projects has continued. This has involved checking, comparing and refining the list based on the clusters knowledge experience and directly involving practitioners, and analysis of commercially available products.
Further review and analysis of the existing CBRNE products on the market, which fill the gaps on the ENCIRCLE list will continue together with the work on generation of the ENCIRCLE innovation roadmap

2.2   ENCIRCLE WORKSHOPS AND EVENTS – YEAR 4

The following events and workshops have been supported or arranged by ENCIRCLE over the last year include

2.2.1   Conferences and events

The following conferences and events were supported over the last year

- Networks of Practitioners Meeting – September 2019

- IFAFRI workshop October 2019

- 21st International CBRN Symposium – 14 November 2019 (CBRN UK, BAES, FALCON)

- COU workshop at SRE2019 – Helsinki, November 2019

- ENCIRCLE Workshop at 21st International CBRN Symposium – 14 November 2019 (CBRN UK, BAES, FALCON)

- NO FEAR-Stair4Security Workshop, November 2019, Rome – (UCSC, IAI, BAES)

- INCLUDING 1st Workshop on the Radiological and Nuclear Training in the EU, January 2020, Rome – (IAI, Miksei)

- DRIVER conference – Participated in Conference in Feb 2020, and DRIVER exploitation follow up

- RESIST Validation Workshop, CBRN training and equipment needs assessment, February 2020, Rome – (IAI, UCSC)

- DRIVER+. Attended end of project market related workshop/conferences. June 2020

- IFAFRI workshop June 2020

- FIRE-IN June 2020 virtual

- ENCIRCLE Catalogue Webinar, July 2020 – (UCL, BAES, UNS, EU-VRi)

- ENCIRCLE/SERSing Meetings August 2020

- SERsing Kick-Off Meeting, September 2020 – (UCL)

- Stair4security, NO-FEAR virtual meetings January, February, March, May, June, July, September 2020

- DG ECHO Standards discussions – September 2020

2.2.2   Standards Initiatives

ENCIRCLE has continues to liaise and work with the Stair4security project over the last period, which includes the agreement in principal of ENCIRCLE Dynamic catalogue information being included in the Stair4Security platform.

2.2.3   Other dissemination activities

In November 2019 ENCIRLE issued the 3rd edition of the ENCIRCLE magazine, detailing updates on this project, the Part b projects COSMIC, EU-Sense and TERRIFFIC, as well as the eNOTICE Project.

In February 2020 ENCIRCLE also issued the 3rd edition of the electronic newsletter, this again detailed ENCIRCLE project updates as well as containing a success story from one of the consortium members PIAP, and information on various practitioner led EC projects.

Consortium member Falcon Communications also contributed an article to the DG Home CBRN Newsletter looking at the work the EC is doing to deliver a holistic structure to shelter European citizens and responders, and how ENCRICLE fits in to that vision.

ENCIRCLE conducted a webinar in July 2020 to practitioners and members of the commission to give a presentation and demonstration of the ENCIRCLE dynamic catalogue and the ENCIRCLE innovation watch and preliminary market analysis results.

2.3   MARKET AND BUSINESS SUPPORT

2.3.1   Market analysis

Building upon the 2018 Market Analysis Report, a number of polls have been conducted primarily using the SLIDO platform. These polls were available in the English, French, Italian and German languages and were targeted at the industrial and practitioner and technological communities.

As was the case with the polling conducted for the 2018 poll, the number of responses garnered for these latest polls were not as widespread as would have been ideal and the ability to be able to get a large response clearly remains an issue going forward. The reasons for the difficulty in being able to achieve a large uptake can only be speculated at but undoubtedly the scarcity of first responder practitioner time to participate in such exercises – especially against the COVID-19 background – must be a key and relatively constant factor. It should be noted that there was a conscious decision to keep a core of the most recent polling questions substantially either the same or closely related to the questions used in the 2018 poll in order to try and better identify any linear trends.

The results of this latest polling are being made available separately in an updated ENCIRCLE market analysis report which will be accessible via the ENCIRCLE Networks & Groups Forum, under Resources. A high-level summary of some of the findings are as follows:

-    Many of the attitudes toward the market identified in the 2018 Market Analysis Report remain valid, including, for example, the slightly anachronistic attitude towards Standards where similar numbers of respondents identified that they believed Standards to be helpful in terms of encouraging innovation and new market entrants but these were 'balanced-off' be the

number of respondents who thought that the Standards applicable to CBRN were outdated and of little use. A similarly consistent theme emerged with respect to the perceived importance given to the need for PPE (and improvements thereto) and the need for better CBRN Information Management/Situational Awareness systems (or, "Warning & Reporting" in NATO military language), particularly for systems that could be used for civilian response, which in turn both creates and sharpens the implications around the need for better interoperability, both between military and civilian response and amongst the different civilian response organisations; this of course then raises further implications in such areas as Standardisation, Communication Protocols/Interfaces and terminology. The area of Detection, Identification & Monitoring (DIM) was also a consistent area where technological improvements are perceived to be needed;

-    It was not entirely clear at what point per respondent the effects of the COVID-19 situation manifested themselves and to what degree of depth (the 2020 Poll closed 31.7.2020, but many of the responses were received well prior to this date) , suffice to say that a clear consequence was that biologically based threats had significantly moved up from the 2018 survey rankings and were now seen, along with the 'new' category of "hybrid" threats introduced for the first time in the 2020 poll, as the major threat source in the coming $5-10$ year period. In the coming 12 -24 months it will be interesting to see what the longer term consequences of COVID-19 will be: it may be that the financial consequences of the widespread lockdowns to individual national economies will be bound to result in less funding being available than might normally have been expected, and/or; as happened with Ebola in 2014, it may that there has been a 'disconnect' in the minds of people within governments of a pandemic with CBRN (when, in fact, many of the containment and response lessons were already well known to CBRN professionals as part of 'normal' CBRN disciplines). Suffice to say that in a post COVID -19 world many of the survey responses and views which ENCIRCLE (and others) have garnered over the last two years might well be changed with consequent impacts on the market and technology supply base which might be difficult or impossible to predict currently.

2.3.2   Business Models and Plans

The business plan maturity model which is being used to monitor TERRIFFIC, EU-SENSE and COSMIC has been reviewed and updated during the last period. ENCIRCLE and TERRIFFIC are collaborating on a market analysis study.

2.4   INTEGRATION AND TECHNICAL SUPPORT

2.4.1   Standards and Interfaces

The work to update the list of CBRN standards is still in progress and is about to end.
We received several lots of feedback from the Encircle forum, and through specific contacts of the CBRN network, about existing standards and potentially useful standards.

Starting from these inputs, Tecnoalimenti are currently working to integrate the seven lists of standards divided by category: (1) Search and detection identification and monitoring, (2) Protection, (3) Information management, (4) Hazard source neutralization or reduction, (5) Decontamination and depollution, (6) Medical countermeasures, (7) Communication.

In this step, particular attention is paid to the standards not yet official but in process of publication and to the gaps, that is the standards considered potentially useful but not yet existing (for this purpose, a specification has been added to the cataloguing matrix to indicate the "*desired*" status) Moreover, compared to the previous version of the list of standards, the standards no longer active have been removed

Standards Organisation Participation

ENCIRCLE partners are providing participation into the following specific CWAs that have been activated:

- CWA on Interoperability (CWA Int) – ADS CBRN UK
- CWA on Trial Guidance Methodology – TCA and ADS CBRN UK
- CWA Simulated Environment (CWA Sim) – ADS CBRN UK

In addition ENCIRCLE has been collaborating with Stair4Security

2.4.2 Integration Platforms

The ENCIRCLE Project has generated a guidance document on the subject of "Platform Integration", which provides a comprehensive description and definition of the term "Platform Integration" in a CBRNE related context. The existing CBRN integration applications, their requirements, and main standards are also introduced in the document. Within the ENCIRCLE Project this is the basis for the preparation of the Research and Innovation Actions (RIA) aimed at research and development of novel CBRN technologies and innovations providing solutions for the gaps and needs identified in the security market by end-users. The document is based on CBRN applications on the market and in the use, not forgetting innovation and under development CBRN integration applications. The document also provides guidance to innovators on what considerations should be considered to allow cost effective integration of their solutions with systems and platforms. The latest version of document can be found in the ENCIRCLE the repository.

2.4.3 Human Factors

Human Factors and ergonomics have the objectives to reduce human errors, increase safety, comfort and productivity considering the interaction between the user and the object.
In ENCIRCLE we have dedicated a task for it that is led by Università Cattolica del Sacro Cuore (UCSC) together with Sieć Badawcza Łukasiewicz – Przemysłowy Instytut Automatyki i Pomiarów (Ł-PIAP).
As Human Factor Task we are at disposal of all Part B projects to assist them in the development of their solutions and we collaborated in the definition of Part B topics together with the rest of the ENCIRCLE project. We produced two non-deliverable documents, namely "ENCIRCLE Human Factors Questionnaire – Analysis" and "ENCIRCLE PPE Human Factors linked to COVID-19". For the first document we started from a literature search, then we drafted a questionnaire that focused on 4 main areas (PPE, Detector, Drone and Robot) and disseminated it. The questionnaire, published on EU Survey platform received answers from very skilled personnel (average experience being of 11,5 years)

and was analyzed in the document already mentioned. The conclusions were really interesting and include:

- PPEs: without taking into account the various level of protection, responders have suggested the following areas as a priority: Ergonomy; Thermal burden; Possibility to easily communicate with colleagues; Versatility (use for chemical, biological, radiological protection). Responders expressed their concerns on gloves thickness, the height difference between old and young soldiers and ballistic protection (suits and plates) for women.
- Detectors: responders assigned an high priority to the User-friendliness/intuitiveness of usage and Presence of alarm items. For this last item they would appreciate to have a detector that, when the alarm is on displays information, has a flashing light and vibrates. They wish to have Buttons or switches to control detectors while dressing PPE.
- UAVs or drones: responders have suggested the following areas as a priority: User-friendliness/intuitiveness of usage; Modularity; Interoperability; Fast deployment; Ability to operate in various weather conditions. The word most associated by responders with their attitude towards the UAV is Trust. Most of the responders use UAVs rarely.
- UGVs: responders assigned a high priority to the following areas: Ability to operate in various weather conditions; Use with other devices (controllers, displays, audio, ...); Controller's usability; Possibility of decontamination. The words most associated by responders with their attitude towards the UGV are Trust, Efficiency, Simplicity.

On March, 13 the head of World Health Organization (WHO) reported that Europe was becoming the new epicenter of the COVID-19 pandemic and as Task we felt the need to give our contribution to the discussion. The non-deliverable document was designed to discuss some of the considerations that were already made by different entities (i.e. Royal College of Nursing) and to organize them in a useful way for stakeholders. We considered PPE availability, problems associated with PPE, badly fitting PPE and the procedures that the Healthcare workers are asked to perform while dressing PPE as well as other factors implicated. The document has not the objective to be exhaustive and comprehensive since the COVID-19 pandemic is still ongoing and we expect many contributions on this. To conclude, the scope of the PPE is to provide protection but, thanks to new materials and know-how, we might expect an improvement of ergonomics, helping HCWs to carry out their activities in an easier way. The process of PPE re-design should involve all the actors, from end-users to manufacturers, taking into account users' needs and new technologies that may be useful.

All the documents are available on ENCIRCLE Forum, accessible upon registration.

2.4.4   Impact Policy and Exploitation

In order to examine the potential improvements for the procurement process organisational documents have been identified. These are mainly national level documents (e.g. Public Procurement Law), but also documents on European level (which apply to EU Member States). Due to the amount and volume of the documents, the analysis has been focused on one country – Poland. Almost 20 documents regarding security and defence procurement have been identified. The analysis of their records is currently finishing. When finished, the summary, presenting the most important issues along with some comments, will be prepared.

Based on the log data from project's catalogue and forum, the analysis of the user activities has been carried out. The summary of the analysis is being prepared. It will show, in form of graphs and numbers, how users use and update the catalogue and forum and what is the impact of consortium's dissemination activities on the usage of the catalogue and forum by their users.

ENCIRCLE is cooperating with iPROCURENET and was to support their workshop before cancelled due to COVID travel restriction,

A key activity over the next period will concern the sustainability of the cluster and networks and discussion to date on this are presented in section 2.5

2.5   ENCIRCLE SUSTAINABILITY

In the last quarter of 2019 ENCIRCLE started to look at sustainability options, the following text summarises the latest discussions and thoughts in the area which are still under development. The consortium would welcome comments in this area:

2.5.1   ENCIRCLE Catalogue

The ENCIRCLE catalogue will be maintained in its current form by UNS for a period of two years after the project completes at the end of August 2021. Before the end of the ENCIRCLE project the intention is to get in place a new neutral management board and this will be a primary activity over the next nine months. The intention is to close the Networks and Forum facility at the end of the ENCIRCLE project, a new repository will be investigated to host the ENCIRCLE resources.

2.5.2   DRS04 Part B Project Support

As part of the support of the DRS04 projects, for when the ENCIRCLE project finishes, a toolkit is being prepared of the ENCIRCLE resources to support these projects. This toolkit will be available in the Network and forum resources folder whilst the project is active, and move to a new repository when the project completes.

2.5.3   ENCIRCLE Cluster

A number of options are being explored concerning the sustainability of the cluster. These include the potential progression of ENCIRCLE into a new CBRNe thematic working group as part of the Community of Users. As part of this activity the following process is inspired by discussions with DG HOME on how a practical implementation of a Capability Based Approach in the field of security and in support to security research planning could look like. It should be noted that the following approach does not reflect any actual or planned implementation, but is just a conceptual model that could serve as a reference for a potential future workflow to be supported by the Community of Users. The following diagram from DG HOME illustrates a high level capability based research cycle process and the subsequent sections which ENCIRCLE has developed further to provide. The ENCIRCLE consortium would welcome inputs from interested parties on this process and the evolution of the ENCIRCLE Cluster. Please contact the consortium of you are interested in this process
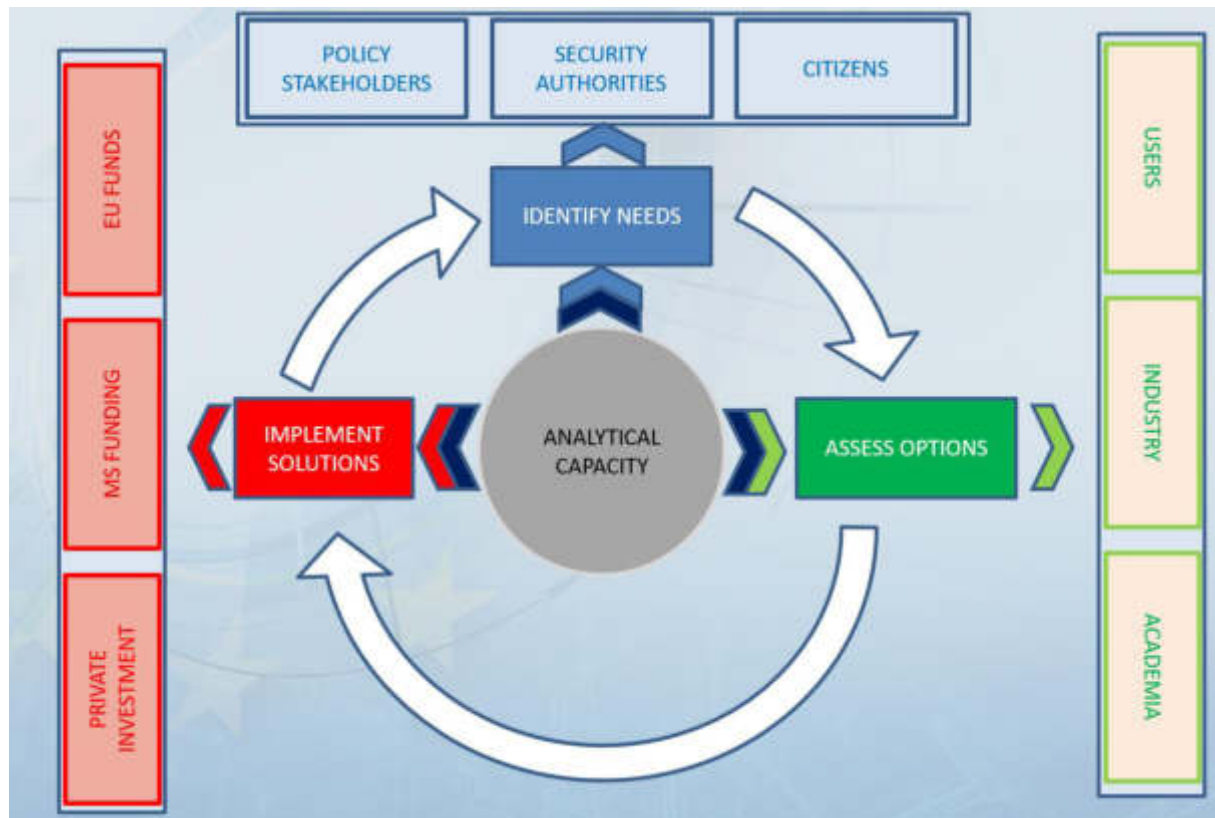
Figure 14 Capability Planning Model (SOURCE DG HOME)

The individual process steps is then illustrated further with a high level description

2.5.3.1   Identify Needs

This process step takes into account policy priorities, and the future threat landscape and conducts a capability assessment to define capability gaps and a capability development plan.

As part of the capability assessment there are a number of constraints that are taken into account. These include whether the solution assessed in the Assess Options stage has resulted in a solution that is not value for money, and the results of the operational reviews of deployed capability.

As part of the capability plan development as well as the capability gaps to be closed, and additional input concerns whether there are any European sovereign capability needs and constraints for the development of such capability.
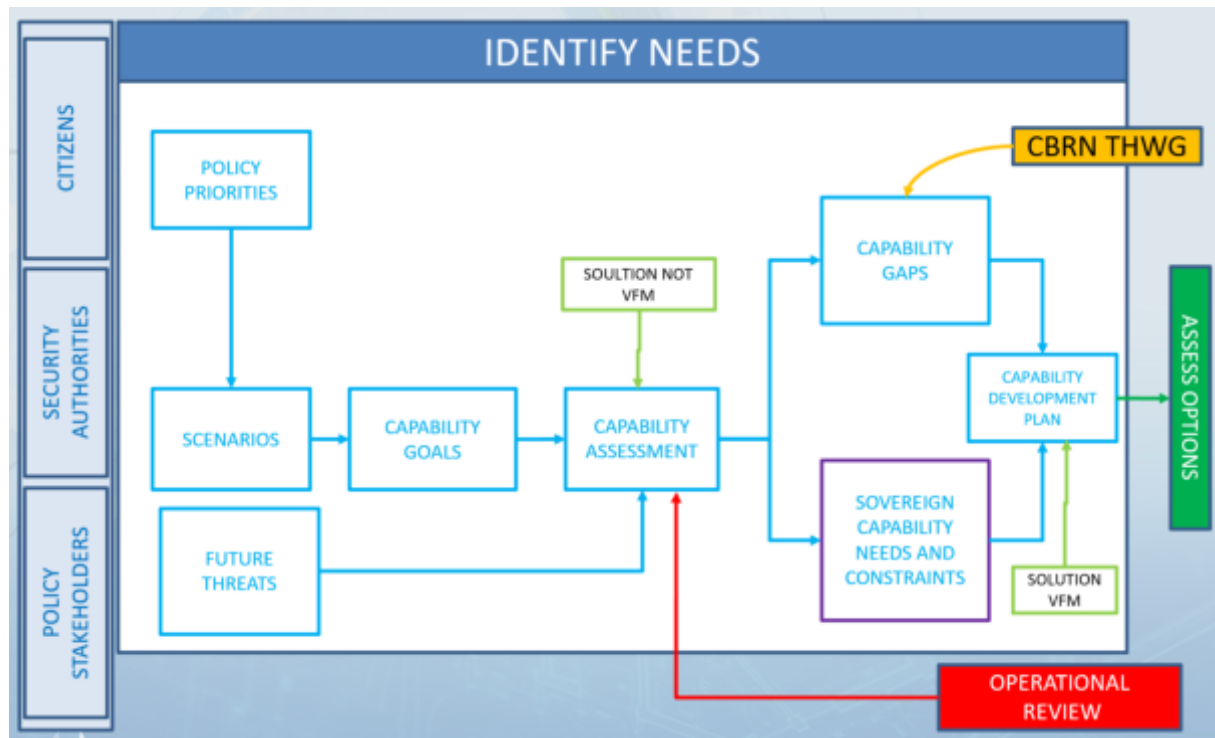
Figure 15 Identification of Needs

2.5.3.2   Assess Options

The assess options process stage includes a state of the art assessment and prioritisation process and then an assessment on whether the solution is affordable.

- The State of the Art assessment takes as its inputs:
  - The capability plan from the Assess Needs process
  - The outputs of the innovation watch activity
  - The outputs of other mission areas or domains which may have sovereignty constraints on technology deployment, operation and maintenance
  - The output of the process step is
    - A prioritised list of potential solutions and requirements in terms of
      - Criticality
      - Urgency
      - Maturity
      - Resources
      - And Sovereign constraints
    - A value for money assessment is then conducted which if successful will then enter the implementation stage
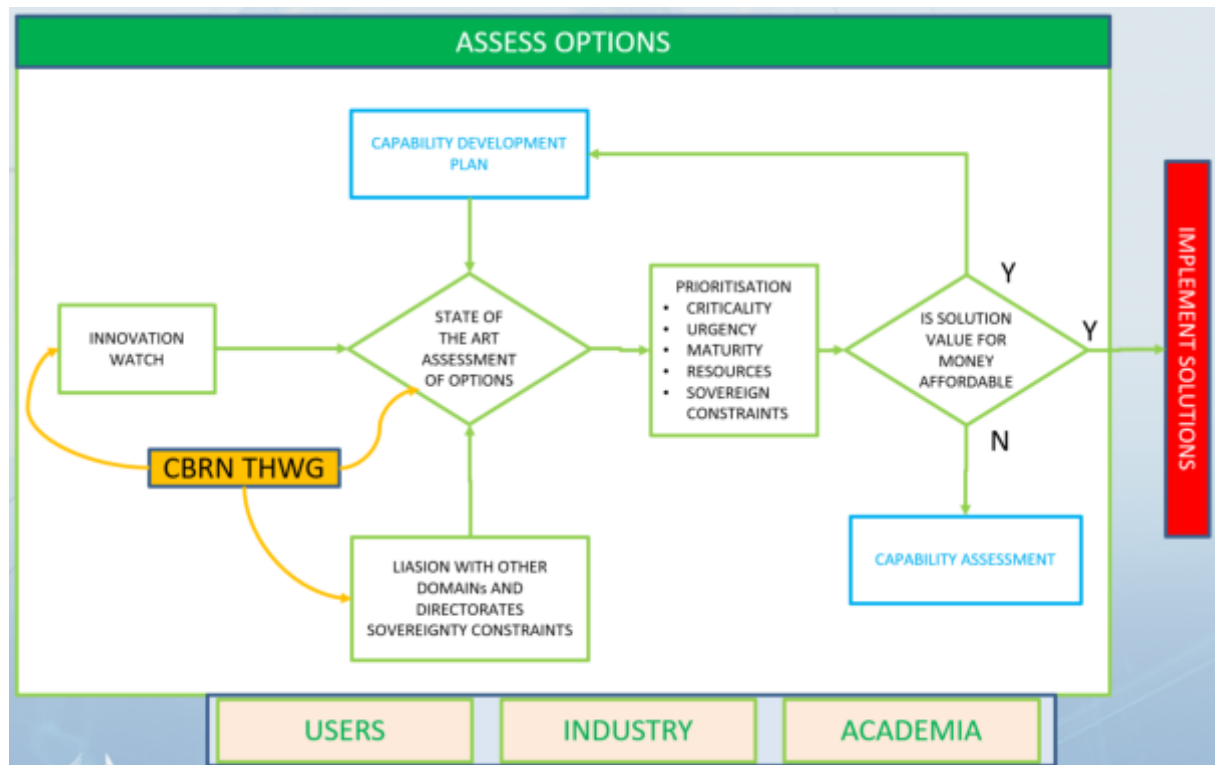
Figure 16 Assess Options

2.5.3.3   Implement Solutions

This process step takes the outputs from the Assess options stage, and then checks depending on the constraints whether solutions are available in the market, could be developed with State of the art technology or whether a research and innovation programme is required. Depending on the answers to these questions the development and integration process is initiated, and then acquisition and deployment. As a final step an operational review is conducted on the deployed solution which provides feedback back into the Needs process
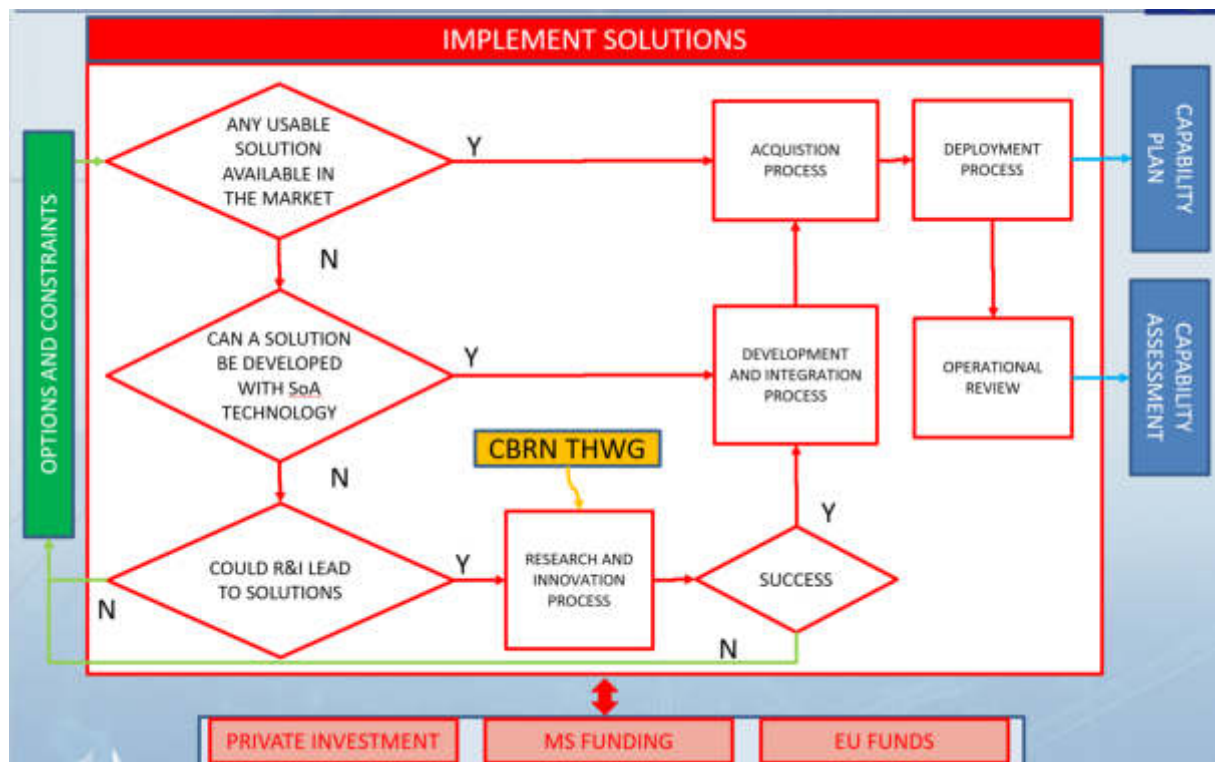
Figure 17 Implement solutions

2.5.3.4   CBRN /expert group

The final diagram summarises where a new CBRN Thematic working group or expert group could provide an input into the overall capability research process. ENCIRCLE will be looking at options on how this group could be introduced once the formal ENCIRCLE project completes, and would welcome inputs in this area.
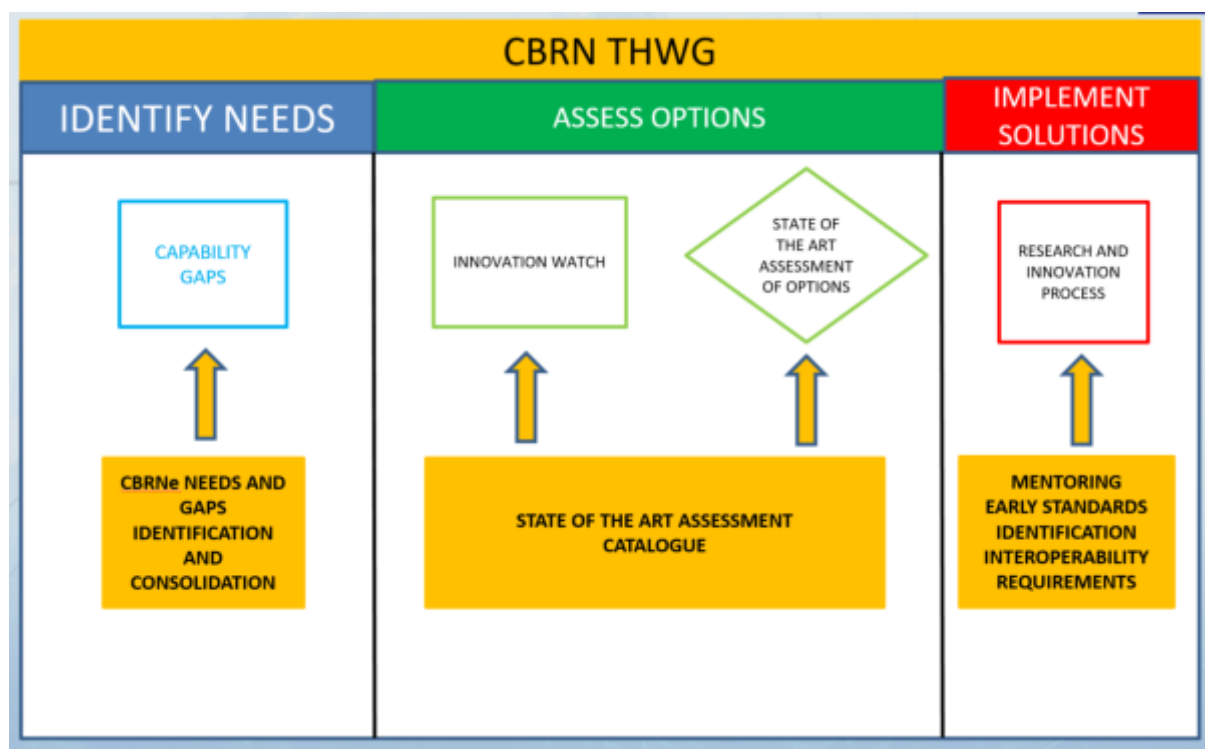
Figure 18 CBRN Thematic working Group

2.5.4 ENCIRCLE Impact

The following table summarises the impact of the ENCIRCLE project to date to shorten the time to market for novel CBRN technologies and innovations against the project objectives

	Impact	Status
a	Provide an early identification of needs and markets for new innovations	The needs and gaps from the EDEN project have been updated and relationships are in place with the practitioner networks. These needs and gaps have been prioritised for the DRS calls in collaboration with the practitioner and technological communities and DG HOME. The ENCIRCLE market surveys have provide an early indication in the change of needs such as the increased emphasis on the biological threat and the improvements required for information management and DIM
b	Provide early identification of new products and innovations	The ENCIRCLE Dynamic Catalogue has 287 registered organisations and contains 277 tools. The innovation watch resource is operational and includes an "innovation watch" widget which presents potential interesting novel innovations and a "radar" widget that provides a pre-analysis on on-going developments in the field of CBRN
c	Support better exploitation of previous and current innovation projects, including orphan results, through	Links to financial instruments to support innovations are available on the ENCIRCLE project site. ENCIRCLE has been working with TERRIFICC, COSMIS and EU-SENSE in supporting their innovations and tool kits are being put in

	identification and facilitation of the most appropriate financial instruments,	place to support the 2019 and 2020 projects when the ENCIRCLE project finishes. As part of the project support IPR assessments and business maturity assessments have been made to start to support their needs
d	Provide recommendations to fill/meet important gaps through the Part b calls,	The recommendations for the topics to be included in the 2017, 2019 and 2020 DRS Call were successfully completed. This included a lessons learnt exercise after the 2017 call for the 2019 and 2020 calls.
e	Provide improved and easier integration and interfaces between research results and products and existing practitioner and user systems, by sharing commercial efforts and access to market between SME and large industries cooperating in the cluster	An integration report has been produced and an an interface and standards collection and assessment exercise has been conducted. Within the ENCIRCLE Resources on the network and forum Resource site the latest integration report and standards database can be found. A Market analysis was conducted and is also posted in the ENCIRCLE Dynamic Catalogue Network and groups forum in the resources folder. In 2020 an updated market analysis has been conducted which considers Needs and gaps, standards, procurement, policy and the market and this will be available October 2020 in the same repository.
f	Speed up the European CBRN innovation capacity by its open, standardised interfaces and its portal facilities (catalogue, community network, market place)	Interfaces to allow better integration of CBRN solutions were collected and workshops conducted in 2019. Recommendations have been made for standardised communication protocols and for Civil Protection symbology. The ENCIRCLE Dynamic catalogue includes functions for the catalogue, community and market place.
g	propose innovation topics that will meet the significant market current and forthcoming needs for the Part b call	The 2017, 2019 and 2020 calls have all been successfully completed
h	speed up the European innovation capacity in CBRN through the use of standardised interfaces. The integration of new knowledge will be included in the Portal (catalogue, expert network and market)	Interface and standard information have been collected, policy, procurement and market analysis surveys have all been conducted and analyses and the results presented at the COU's and documented in the ENCIRCLE Market Analysis reports.

2.6   ENCIRCLE REQUEST FOR INPUT

The consortium welcomes views and inputs concerning all the sustainability options discussed in the preceding sections these include:
- Creation of the new management board to manage the ENCIRCLE catalogue after August 2021
- Transition of the ENCIRCLE Cluster into a new CBRN experts group
- Transition of ENCIRCLE resources to a new repository

Please contact the ENCIRCLE Co-ordinator and Technical co-ordinators directly with your inputs before the end of November 2020.