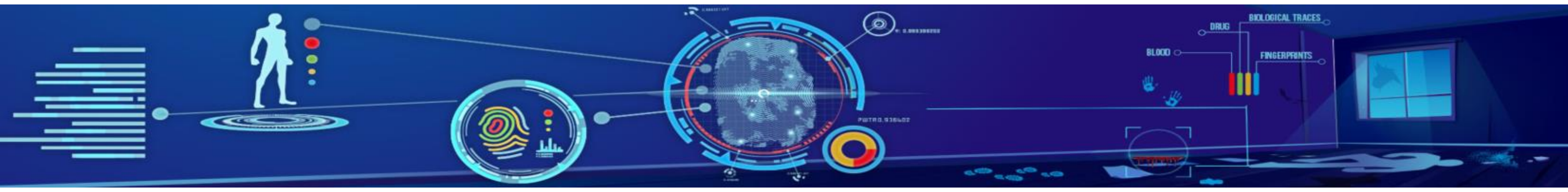


Issue No. 3, January 2022

The RISEN Project

The aim of the RISEN project is to develop a set of real-time, contactless sensors and an Augmented Crime Scene Investigation system for the optimization of trace identification, classification and interpretation on site, capable of creating an interactive 3D model of the crime scene with the position and labelling of traces and the relative results of the on-site analysis.

The RISEN Consortium comprises 20 partners from 12 different European Countries that represent Research Institutes, Law Enforcement Agencies, Universities, Small and Medium Enterprises, and Standardisation Institutes. The management structure of the RISEN project is organized to meet the specific needs and scope of the challenge ahead, ensuring the involvement of all partners in the Consortium's decision-making process, whilst retaining the necessary level of autonomy allowing for fast decisions on operational and technical issues. RISEN's management structure consists of two main management boards, the Coordinator Team and the RISEN Steering Board, both supported by the Ethics Advisory Board, the Security Board and the Stakeholders and Practitioner Advisory Board.

RISEN Consortium

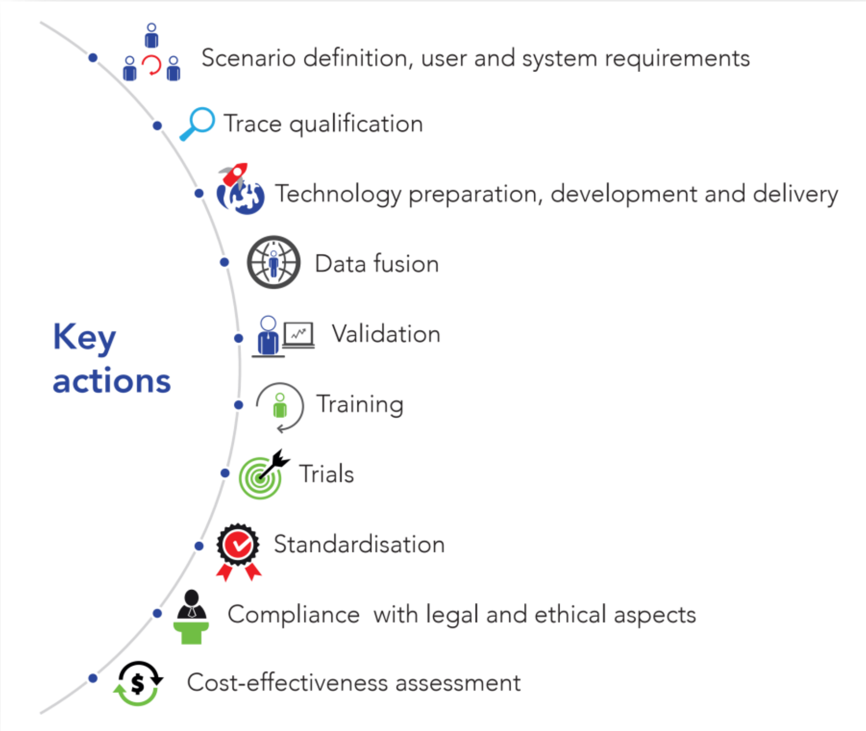
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 883116.

Since the proposal phase, a close interaction with law enforcement agencies (LEAs) has been a key success factor for RISEN. The insightful dialogue pointed out reduced time and lowered resource spending in forensic laboratories, a digitalized chain of custody to assure data integrity over its lifecycle, and a fast exchange of information among LEAs were three main issues to be addressed by the RISEN project. As the project unfolds throughout 48 months, the project partners and members of the Stakeholder and Practitioners advisory Board will have the opportunity to exchange new ideas and build synergies in RISEN's three Workshops.

The RISEN project is accomplished through the scientific and technological innovations stemming from 11 work packages. From scenario definition and the elicitation of user and system requirements to the preparation, development and delivery of technology, RISEN envisions the design and implementation of innovative real-time sensors. These are easily mounted or used at the scene to expedite the collection of trace evidence and optimise its identification, selection and labelling on site, thus meeting pressing user needs concerning the demand for results and time and resource constraints.

In addition, the data acquired in-situ is processed, fused and displayed in a 3D augmented crime scene investigation system, producing an interactive realistic 3D model of the crime scene, available at any time for investigative and judicial purposes.

Importantly, RISEN foresees an extensive training, testing and validation trials program that brings technical partners and LEAs together to improve and mature the RISEN System and enhance the EU's forensic investigation state-of-play. In the process, standardisation and full compliance with existing legal and ethical aspects support the conduct of a thorough cost-effectiveness assessment of the RISEN System, while contributing to reinforce the RISEN's trustworthiness and acceptance by LEAs across Europe.



RISEN Key actions

RISEN Accomplishments

The first year of the RISEN project's realization resulted in the finalization of the tasks within WP2 "State of the art of Forensic trace qualification, requirements and gaps". The WP2 tasks focused on review of the state of the art in areas related to crime scene investigation, forensic scenarios and trace evidence associated with them and covered CSI's operational procedures, technical aspects of CSI, training of CSI personnel, and CSI personnel safety. The important input into this work was provided by RISEN LEAs who, together with Stakeholders and Practitioners Board (SPB) members, gave RISEN project expertise and experience from a total of fourteen LEAs from thirteen EU countries.

The results of the WP2 were described in five deliverables and will serve as a basis for a scientific publication planned to be published in 2022. The RISEN project focuses mainly on the development of tools, which will support crime scene investigation. Therefore, part of the work within WP2 was focused on the review of the tools and procedures used during crime scene investigation. These issues will be covered in a review article focusing on analytical tools for crime scene investigation. The review will provide an updated source of information for any specialist seeking for an optimal approach based on the use of analytical capabilities on-site during crime scene investigations written with the perspective of forensic scientists. In the work in RISEN WP2 we have also focused on the issues dedicated to training of forensic specialists with particular focus on crime scene investigators. The dynamically developing field of forensic science and advancements in new technologies suitable for use in crime scene investigation require from crime scene investigators to undergo continues professional development. Therefore, in a second publication we would like to focus on the issues related to training of crime scene investigators from the perspective of RISEN LEAs.

RISEN is developing sensor solutions for facilitating crime scene investigation on-site. Furthermore, a 3D reconstruction and positioning tool will be used to reconstruct the crime scene and map all the sensor measurements onto this reconstruction. Sensor data fused together with the RISEN 3D Augmented Crime Scene Investigation system allows increased analysis of traces while reducing laboratory activities for further analysis, faster information exchange, and digitalization of documentation and the chain of custody. Illustration of the different modules is shown in Figure 1.

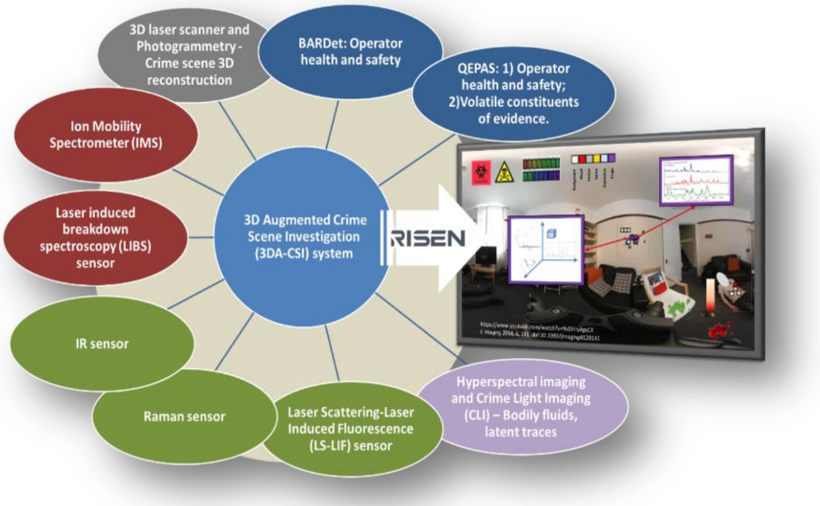


Figure 1. Illustration of the integrated RISEN modules.

The design of the sensors and 3D operations have been documented in deliverable "Specification of the sensor hardware, trace data analytics and 3D reconstruction operations". This deliverable provides the technical elements necessary for the implementation of the RISEN sensing and scanning solution as well as analytics tools for interpreting gathered sensor data into useful information to be used in crime investigation. Also, the actual sensor development has been progressing and first operational units are ready for technical testing during the first half of 2022.

In parallel to the tool development, RISEN is developing the methodology to validate the new system to deploy in the forensic field. The objective of forensic methods is to obtain results with a measurement quality relevant for the criminal justice system (results must be consistent, reliable and accurate). This means that during the process of the introduction or implementation of a new forensic method a specific step must be taken to prove in an objective way that the method is suitable for its intended use. This step is called validation.

Dissemination activities, workshops and trials are important aspects covered in RISEN and, WP10 has been active in the last period with the preparation and submission of the deliverable *"D10.2: Procedures and Criteria used for participants' recruitment / Informed consent procedures for the participation of humans/templates"*. This is an essential deliverable for the forthcoming dissemination activities and workshops, as well as the commencing of preliminary trials. The actions and analysis of the legal and ethical landscape were disseminated in the course of the RISEN workshop, held virtually on 8^{th} of October 2021. The title of the presentation was: "Legal and ethical challenges in the evolving forensics landscape".

Two more important deliverables covering ethical aspects were also submitted during the last 6 months with the aim to:

- provide a report by the Ethics Advisory Board (EAB) in collaboration with the Independent Ethics Advisor (IEA) about how the RISEN Consortium has ensured compliance with ethical standards (national/EU) and guidelines of H2020 and with the specific Ethics Requirements for the RISEN project;
- demonstrate that appropriate health and safety procedures conforming to relevant local/national guidelines/legislation are followed for staff involved in this project.

Introduction to the RISEN Tools (Part 2)

Infrared (IR) Sensor

The RISEN IR Sensor refers to a tool for the stand-off detection of forensic-relevant substances by means of backscattering IR-spectroscopy. The detection principle behind stand-off backscattering IR-spectroscopy is simple: a sample (e.g. a "bulky" solid for instance a pill or a "porous" sample like powder dispersed over a substrate) is shined at a certain distance by mid-infrared light and a spatial portion of the diffusely reflected (or, equivalently, back-scattered) light is recorded. Contrary to other techniques like e.g. Raman, the frequency range of shined and collected light is the same, whereas –because of the interaction of the shined light with the sample – the signal intensity at some frequencies of the collected light will be reduced. The corresponding absorption pattern for mid-infrared light (also called "fingerprint spectrum") is unique for each sample, as it is directly related to its molecular composition and arrangement. By comparing the measured back-scattered spectrum with database items that contain diffuse reflection spectra for several samples, one can quickly identify the measured substance. This is for forensic investigations however not a trivial step, as there are no extended database libraries for forensic-relevant body-fluids (e.g. blood, saliva, etc.) as well as only limited database libraries for other forensic-relevant samples as e.g. fabrics. A literature search shows however that it is in several cases still possible to trace back the measured back-scattered spectrum of an unknown sample to its molecular nature, e.g. to answer a question like "is this sample of biological origin (e.g. blood) or is it paint?". For the case of biological (forensic-relevant) samples, this level of detection is facilitated by using specific mid-infrared (MIR) frequencies or frequency-bands that strongly interact with functional groups characteristic for biological samples (e.g. amides). Furthermore, by using mathematical methods as e.g. multivariate statistical analysis, it is in some cases also possible to do a more refined distinction, e.g. to identify a particular body-fluid substance.

For the purposes of forensics, using MIR light represents an excellent complement to near-infrared (NIR) light, essentially because of the better selectivity in the substance identification. Stand-off MIR back-scattering remains however absent in a typical crime scene investigation. Rather than responding to fundamental scientific limitations, this absence responds to the fact that no mature developed systems are available. Some studies have however been reported, illustrating the potential of backscattering - as well as attenuated-total-reflection (ATR) MIR spectroscopy as a tool for the identification in forensics. In those cases, a Fourier-Transform-InfraRed (FTIR) spectrometer has been used for the signal acquisition. In short, FTIR has one clear advantage (the usage of a broadband light source as a globar) and two disadvantages: the low brightness of the light source and the resolution-dependent acquisition time. These disadvantages are left up by the spectrally-combined QCL-approach within the RISEN IR-Sensor. As a matter of fact, an external cavity tunable quantum cascade laser (EC-QCL) is a highly brilliant light source, which in turn translates into excellent signal-to-noise ratios. Furthermore, by using a resonant micro-opto-electro-mechanical-system (MOEMS)-based grating as a wavelength tuning element, a MOEMS EC-QCL light source (Figure 3) can achieve tuning speeds in the kHz range (i.e. an acquisition time of the order of 1 millisecond for a full spectral scan).

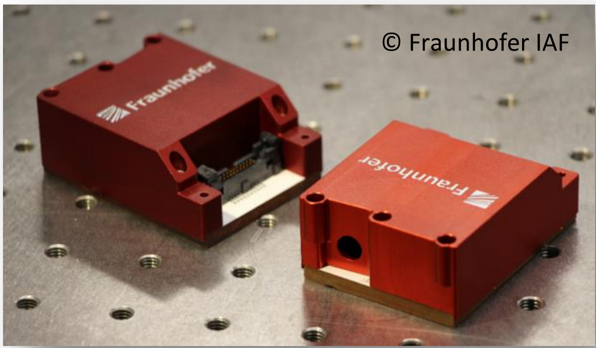


Figure 2. Miniaturized, broadband spectrally tunable MOEMS EC-QCLs with emission wavelengths in the mid-infrared range and high scanning frequency up to 1 kHz. Such tiny, palm-size devices are developed at the Fraunhofer Institute of Applied Solid State Physics (IAF) in collaboration with the Fraunhofer Institute for Photonic Microsystems (IPMS).

Finally, the RISEN IR Sensor will seek to spectrally and electronically combine two MOEMS EC-QCLs in order to simultaneously measure two spectrally separated regions (e.g., ~1500-1700 cm^{-1} to address the amide I and II region to detect biological samples and ~1000-1300 cm^{-1}, which falls into the atmospheric transmission window i.e. offering large standoff distances as well as providing very characteristic spectra for a huge number of substances).

The RISEN IR Sensor should serve for a first assessment of a crime scene by its 3D scan capabilities, as well as to provide a quick alert to LEAs in the case of presence of dangerous substances (e.g. explosives powders dispersed over a desk or a wall). The sensor operation will require only one person and, on demand, the trace identification results will be displayed in real time on a display attached to the sensor. The trace identification results will consist on the name of the identified substance. The results will further include other scan data as the sensor’s spatial orientation as well as the time, so that they will serve as complementary information to the other RISEN sensors. As of December 2021, a first prototype of the RISEN IR Sensor is being finalized. First data acquisitions tests are expected for the beginning of 2022.

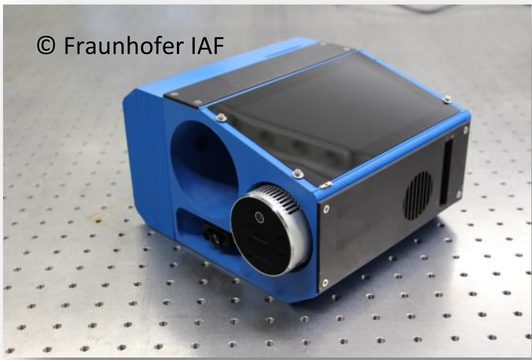


Figure 3. First RISEN IR Sensor prototype, as of December 2021.

Ion Mobility Spectrometer (IMS)

The RISEN ion mobility spectrometry (IMS) is a powerful analytical technique based on ion molecular interactions in homogenous electric field. The main advantages of this technique are: compact design, high sensitivity (ppb-ppt level), fast response (ms range), operation in atmospheric pressure and ability to separate isomeric compounds. Traditionally, the IMS instruments consist of three major parts: ionization region, reaction region and drift tube. The schematic view of ion mobility spectrometer is shown in Figure 4.

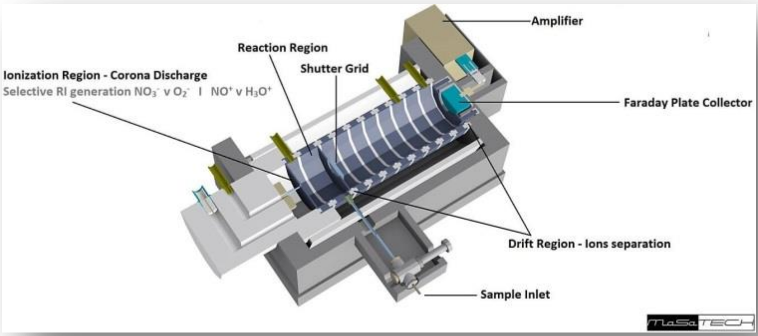


Figure 4. Schema of IMS.

The ionization source used in ion mobility spectrometry instruments developed by MaSaTECH is a non-radioactive corona discharge (CD), which offers CD up to 1 order higher signal yield compared to radioactive ionization sources. The higher signal generation is closely related to higher sensitivity and better signal to noise ratio. The ions generated from CD react with sample molecules in the reaction region of IMS. Based on ion molecules reactions the new product ions are formed in reaction region of IMS. In the following step, the ions are injected by Bradbury Nielsen shutter-grid to IMS drift tube. In IMS drift tube ions are separated based on their mass and molecular cross sections. This separation is also known as reduced mobility. The value of reduced mobility is for each kind of ion unique, which allows direct identification of sample molecules.

The IMS developed for RISEN will operate in sub-atmospheric pressure. This will allow us to use various sampling technique that can be useful for RISEN. The possible sampling techniques that can be used are:

1. Continuous sniffing. This approach will allow for real time monitoring of environment for instance with the aim to identify anomalies in atmosphere like acetone, ammonia, acids.
2. Laser desorption. This approach will allow us to analyse solids, surfaces or materials with high boiling point. Such sampling technique is good for analysis explosives and illicit drugs.
3. Head space sampling. This technique is optional for analysis of liquid at the scene of crime.

Furthermore, the fast pre-separation can be used to analyse the complex matrix if it will be required. The prototype under development for RISEN is shown in Figure 5.

Figure 5. The IMS developed for RISEN project.

The IMS can be useful for detection of volatile compound, illicit drugs, explosives, chemical warfare agent, for distinguish between substances like blood and ketchup. It will be also useful for analysis of gases, solids and liquids.

RISEN Dissemination activities

1st RISEN Workshop on New trends in Crime Scene Investigations

The RISEN Consortium organised the "1st RISEN Workshop on New trends in Crime Scene Investigations" which took place on Friday, 8th October 2021 (virtual event, Figure 6).

The Workshop aimed to bring together leading Law Enforcement Agencies, Academic Scientists, Researchers, Standardisation Organisations and SMEs to exchange and share their experiences and research results on all aspects of Crime Scene Investigations. The purpose of this Workshop was to introduce the many challenges that forensic practitioners have to face during CSI and how to overcome these challenges. Moreover, it provided information about some of the latest state of the art techniques for crime scene analysis and documentation like those proposed by the RISEN project.

During the Workshop, real case studies were presented to:

- understand the state of the art of the forensic methods and technologies in use for CSI;
- discuss challenges and gaps (technological, training, procedural, standards, safety, legal);
- identify user requirements for on-site CSI.

Figure 6. Speakers from the 1st RISEN Workshop on New trends in Crime Scene Investigations.

The total number of registered people to the event was 200 representing LEAs, Universities, research institutes, SMEs and standardisation institutes and, a total of 26 countries were represented by LEAs (Figure 7).

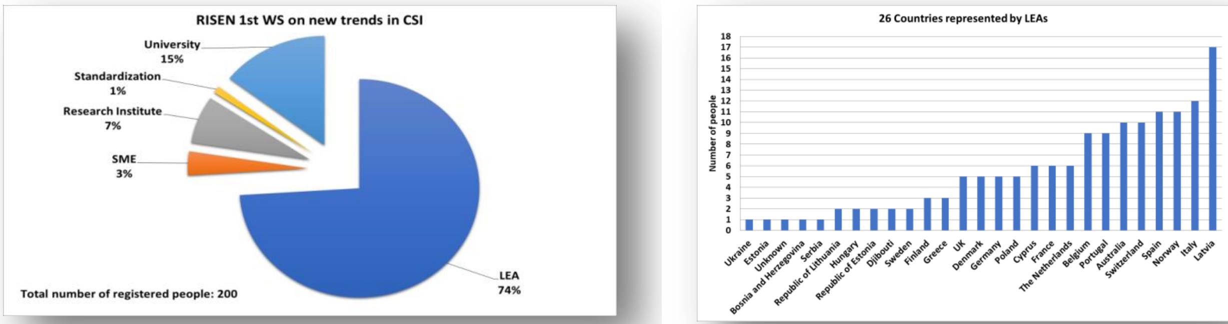


Figure 7. 1st RISEN Workshop on New trends in Crime Scene Investigations.

The WS agenda was organised in three main sessions:

1) Setting the scene;
2) Needs and requirements;
3) So what, and the RISEN approach.

In the first session – Setting the scene – the keynote speaker from the European Commission (DG Migration and Home Affairs) introduced the CSI and EU Security research focusing on the EU funded security research. One important takeaway from the presentation is the emphasis on "the capability-based approach" and the important fact that research is a part of a wider process including the five main actors: researchers, policy makers, practitioners, industry and citizens. According to the European Commission, the biggest challenge is innovative uptake, the capability development synergy circle (Figure 8).

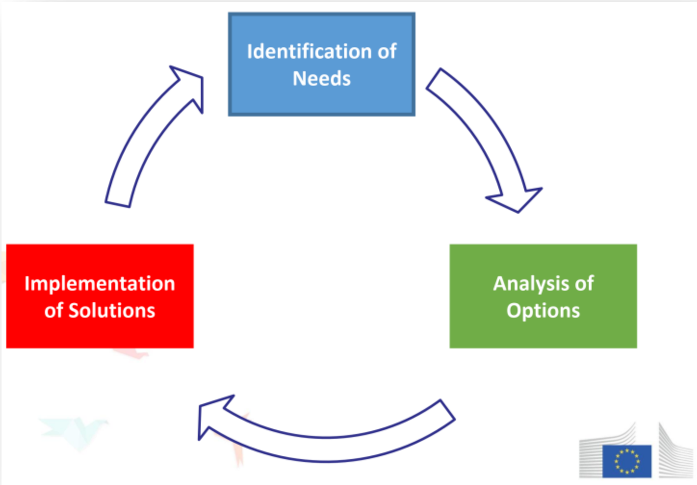


Figure 8. The Capability development synergy circle (European Commission, DG Migration and Home Affairs).

Following the presentation by the keynote speaker, Interpol introduced the audience to the new Interpol Incident Exhibits Book for conventional and contaminated crime scenes. The presentation highlighted several important aspects of the first block in the synergy circle (identification of needs), such as the importance of recording as much detail as possible and the need for high quality records. In the final presentation in the first WS session the RISEN project coordinator, introduced the audience to the RISEN project, its aim and objectives.

The second WS-session – Needs and requirements – included three main presentations:

- Crime Scene Investigation – mid- and long-term needs for innovation (Scene of Crime Workgroup, ENFSI);
- Incident response to the Kenyan and Sri Lankan suicide bombings (INTERPOL);
- Information sharing after a CBRNE incident (EUROPOL).

All three presentations focused on needs and requirements related to CSI. ENSFI gave examples to show why and on what topics CSI innovation is needed. One important take away is that increased complexity of crime scenes calls for increased quality in CSI. In the conclusion remark, ENFSI highlighted that "because of the rapidly advancing analysis possibilities in forensic laboratories, the shift towards activity level evaluations, new technology and the influence of human factors, the crime scene has become increasingly difficult".

INTERPOL presented two case studies based on the Sri Lankan bombing events in April 2019 and the Nairobi bombing in January same year. The main take away is again the complexity of the crime scene and the needs for high quality CSI.

In the third presentation in this part of the WS, EUROPOL highlighted another highly complex scenario, CBRNE attacks. Challenges includes the complexity of future attackers using bio agents to combined attacks using several types of agents. Note that bio agents for example are not detectable by the senses and that the time from exposure to onset of illness may vary from days to weeks. For CBRNE attacks in general, challenges may include that perpetrators have plenty of time to flee the scene, a large number of causalities, hugh socio-economic consequences and a cross border dimension. In addition to focusing on the CBRNE threat, EUROPOL emphasised on the need for information sharing across organisations and nations and informed about the EUROPOL system for information sharing and analyses.

The third and final session of the WS – So what, and the RISEN approach – aimed to focus on the second block in the synergy circle (Figure 8) "Analyses of options". This session started by a presentation - CSI: Where to from here – presented by Ecole des sciences criminelles (University of Lausanne, Switzerland). The presentation focused on the use of evolving technologies and stated in his final statement that "some technological developments and the impact of digital transformation are reshaping the practice of crime scene investigation".

In the three following presentations the audience was informed on:

- Ongoing R&D and future developments in CSI (R&D Standing Committee, ENFSI);
- The role of the UK Forensic Capability Network, and how the network delivers, how they include research, validation and use of new technology (Forensic Capability Network);
- The future of crime scene recording in the Dutch national police (Dutch National Police).

The I-LEAD project (Innovation - Law Enforcement Agency's dialogue) was presented by the coordinator (International Engagement Home Office Science). One of I-Leads seven objectives is to create conditions for better interaction with industry, research and academia, and an important activity in the project is the practitioner Workshops. The coordinator summed up the practitioner's wish for a solution as a portable, easy to use tablet type device with the capability to capture 3D scans, locating and recording trace materials, recording finger marks, real time transmission of data, real time analysis, secure storage solution and with a common format and interoperable with other platforms. His presentation ended with the rhetorical question; Will RISEN deliver a solution?

In the two following presentations the RISEN consortium focused on RISEN approach to CSI and how RISEN may address practitioner's wishes.

Presentations by WAT (Poland) and University of Bergamo (Italy) started by reminding the audience on incident and crime scene activities today. Subsequently, the RISEN approach to CSI, with a 3D Augmented Crime Scene Investigation System, was presented and the RISEN aims and objectives were highlighted by Particle (Portugal) and VTT (Finland) (Figure 1).

Legal and ethical challenges and standardisation are 2 important aspects in RISEN captured in two Key User Requirements. The Legal and ethical aspects was in the WS presentation by KEMEA (Greece), and RISEN standardisation approach was given by DIN (Germany).

Focus Live 2021

The RISEN project was presented during the event "Focus Live 2021" which was held in Milan (Italy) in the Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci.

The Project was presented in the time slot "The science of Crime": Serial killers, femicides, terrorist attacks: the TV series have made us all detective. But, in reality, how much do technology and neuroscience contribute to solving criminal cases?

The event saw the participation of the RISEN coordinator together with the criminologist Franco Posa and a representative of the Carabinieri and, it was moderated by Gianluigi Nuzzi, a journalist who has always been at the forefront of judicial investigations.

You can watch the full video (in italian) here:

https://www.facebook.com/focus.it/videos/600711404312507

Upcoming events

RISEN will participate to the next European Academy of Forensic Science Conference which will take place in Stockholm (30 May – 3 June 2022).

FACTS AND FIGURES

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