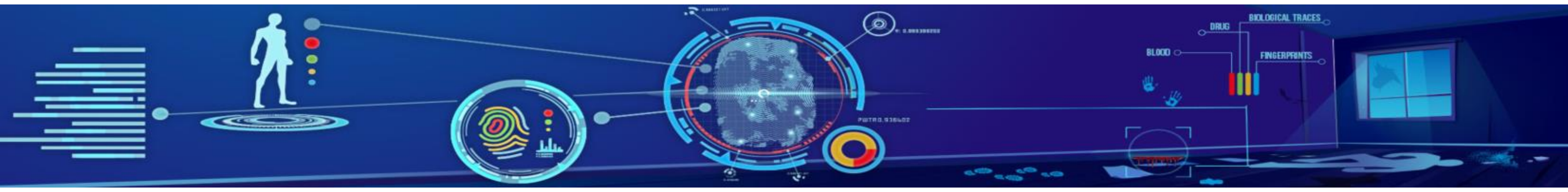
RISEN Newsletter
REAL TIME ON-SITE FORENSIC TRACE QUALIFICATION



Issue No. 2, July 2021

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

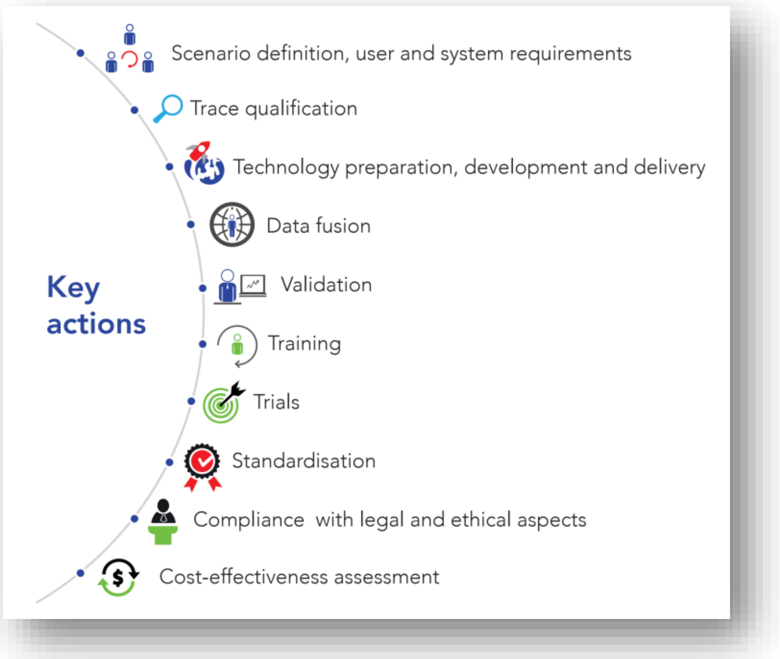
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 883116.

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

During the first year of the RISEN project's realization, the work within WP2 "State of the art of Forensic trace qualification, requirements and gaps" has been carried out. The efforts of the RISEN partners involved in WP2 have resulted in the delivery of five reports focusing on the following areas related to crime scene investigation: forensic scenarios and trace evidence associated with them, CSI operational procedures, technical aspects of CSI, training of CSI personnel, and CSI personnel safety. The state-of-the-art reviews in the five areas mentioned above were based on the review and analysis of publicly available resources, as well as on the information and comments gathered from seven RISEN LEAs, through dedicated questionnaires and during the RISEN workshops. The RISEN LEAs, together with Stakeholders and Practitioners Board (SPB) members, give the RISEN project expertise and experience from a total of fourteen LEAs from thirteen countries.

Based on the interaction with LEAs and SPB members, by participating in questionnaires and the takeaways messages proposed during the 1st internal Workshop (WS1, 9-10 September 2020), a set of main user requirements (UR) were proposed.

The 2nd internal Workshop, which was held on the 27th of January 2021, had the aim to confirm the UR and to define the RISEN system requirements (SR) in collaboration with partner LEAs and SPB members based on the UR identified during WS1. The SR will be further developed over the WP4 "Hardware and software specification definition" duration to produce the final RISEN SR.

This intense and productive interaction with LEAs during the 1st year made it possible to better shape the fundamental overview of the RISEN system specification and architecture (D4.1). The selection of the basic communication technologies, protocols and data formats were presented, defining the key points of the system architecture. By considering the system architecture as a top-level starting point, D4.1 helps to derive the particular specifications for the sensor interfaces (D4.2) and the software APIs (D4.3).

Deliverable D5.1 "Specification of the sensor hardware, data analytics and 3D reconstruction operations" was also submitted. D5.1 contains the technical planning information for each sensor and the 3D-reconstruction development. The deliverable provides technical descriptions on how RISEN sensors are addressing the requirements collected from LEA end-users. Content includes information about user stories: how each sensor will be used by end-users, mapping of technical capabilities with system requirements and preliminary information about the sensor capabilities for detecting and/or identifying different traces in categories: bodily fluids, drugs of abuse, hazardous materials, explosives/reagents and other traces. D5.1 also includes risk analysis, development roadmap and methods for verification that allow planning activities during the second year of the project to be conducted in more detail.

Currently performed training methods and concepts for LEAs will be captured, assessed and evaluated in close cooperation with LEAs. These concepts will be improved and adapted to the new forensic tools developed within RISEN. In a first step, these concepts will be tested to teach project partners without corresponding prior knowledge. After revising, these concepts will be used to train LEAs. The effectiveness of these methods will be evaluated during the RISEN trials.

The RISEN project will also assess cost-effectiveness of the systems and tools developed by the project. To assess the effectiveness, RISEN uses UR, measure of effectiveness (MoEs) and measure of performance (MoPs), and link the MoEs and MoPs to the UR.

The five Ethics Requirements, set out by the European Commission for the RISEN project, were all assessed during the first year of the project with the final submission of five deliverables to:

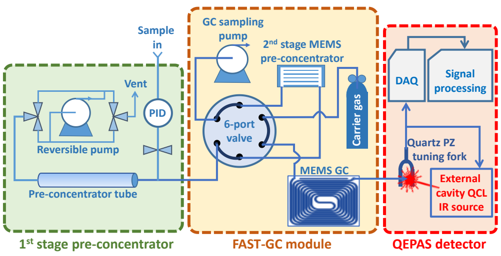
1. illustrate the procedures to be followed by the RISEN Consortium regarding identification/recruitment of the RISEN research participants, the involvement of human participants in research and the processing of personal data;
2. prove that every Partner carrying out research with humans during the lifetime of the RISEN project will strictly follow the necessary procedures and ensure compliance with ethical principles and relevant legislation;
3. guarantee the protection of personal data (POPD), the protection of fundamental rights and freedom of natural persons and, in particular, their rights to the protection of personal data;
4. report on the RISEN Consortium's compliance with ethical standards (national/EU) and guidelines of H2020 and with the specific Ethics Requirements for the RISEN project;
5. demonstrate the awareness on the potential risks to the health and safety of all participants engaged in activities in the course of the RISEN project and report on the measures and procedures that will be followed that conform to relevant local/national guidelines/legislation.

Introduction to the RISEN Tools (Part 1)

Quartz Enhanced Photo Acoustic Spectroscopy (QEPAS)

It is a hand-portable point sensor of Volatile and semi-volatile organic compounds (VOC/SVOC) in the vapour phase, based on fast Gas Chromatography (FAST GC) for chemical separation and on infrared Quartz Enhanced Photo Acoustic Spectroscopy (QEPAS) for chemical analysis. Moreover, it integrates a sampling and concentration module as input stage to improve sensitivity. In RISEN all the components of the FAST GC will be implemented on silicon micro-machined chips. As the term 'fast' suggests, the miniature size of the column allows the separation of substances (including those with higher boiling point) in 2-3 minutes, contrary to traditional columns which require elution times in the order of tens of minutes. The QEPAS module makes use of a Quantum Cascade Laser (QCL) to scan the thermal IR spectrum and to perform the spectroscopic analysis of the chromatographic peaks released by the GC column. Sensing is based on the piezoelectric transduction of the photo-acoustic signal that is generated when laser radiation is absorbed by the vapour.

Signal intensity is proportional to laser intensity, to the absorption cross section of the substance in the QEPAS cell, and to its concentration. QEPAS spectra are very similar to the spectra obtained by classical IR absorption spectroscopy (IRAS), but, unlike IRAS cells, QEPAS cells can be designed as very cheap components of miniature size. The sensor is used for a first assessment of the crime scene, to prevent risks for investigating personnel due to the presence of hazardous VOCs in the air. Furthermore, the sensor helps identifying unknown evidence material and trace back its origin, by providing chemical information complementary to contactless proximity sensors.



Block diagram of the QEPAS system, with the following abbreviations. PID: Photoionization detector; GC: gas-chromatograph; MEMS: micro-electro-mechanical system; DAQ: data acquisition; PZ piezoelectric; QCL: quantum cascade laser; IR: infrared.

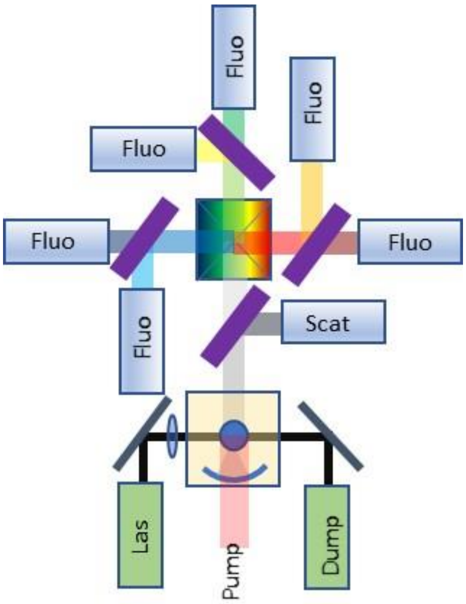
BARDet (BioAerosol DETector)

The BARDet (BioAerosol DETector) technology applies laser induced fluorescence (LIF) for detection of biological particles in air. It uses UV radiation for fluorescence excitation of individual particles. Each particle is characterized by intensity of scattered radiation and fluorescence in several spectral bands. The device allows real-time, continuous detection of bio-agents like bacteria, fungi, spores, pollens suspended in air and distinguish them from non-biological ones. The device is used for real-time warning against airborne biological pollution as well as a part of a pollen monitoring system.

The construction, excluding chamber and electronics, is based mostly on standard, off-the-shelf optical elements. The BARDet is composed of:

1. **Detection chamber and detectors**

Inside the chamber, aerosolized particles that are aspirated along with ambient air passes through the nozzle and are interrogated with UV laser beam. Each single particle is irradiated with laser beam and generates scattered light of the wavelength equal to the incident's light and fluorescence signal if the particle is of a biological origin. The scatter signal is collected via proper PMT and triggers particle counter. Simultaneously fluorescence characteristics are collected separately for each detection band by dedicated set of PMT's. The diagram of the detection chamber with detectors is presented in the following figure.



BARDet detection chamber illustration.

2. **Electronics**

The PMT signals are processed in the electronic module operating with high sampling rate allowing to record signal intensity in each fluorescence and scattering band induced by laser–particle interaction.

3. **Pumps and nozzle system**

The aspiration of ambient aerosol and airflow formation in the chamber is realized with miniaturized electrical pumps. The ambient air is continuously drawn through the nozzle. It is focused with a sheath flow of filtered air. The air after measurement is finally filtered before it is exhausted.

The Interview

Translation from Italian of an interview to Giacomo Galeazzi.

Professor of Criminology, Forensic Medicine for Medical Technologies and Forensic Medicine, Francesco Saverio Romolo is among the most reputable Italian experts in the application of science to scientific crime investigation.

How does science help establish the truth in a forensic investigation?
"Between the end of the nineteenth century and the beginning of the next century, the scientific method grew to become a more and more important tool in policing. In 1903 Salvatore Ottolenghi, a medical examiner, who had grown professionally with Cesare Lombroso in Turin, founded in Rome the first school of scientific police in the world ".

Could you give us an example?
“At the beginning of the twentieth century, schools of scientific investigation for police forces and forensic laboratories spread first in Europe and then in the United States. In the US the first laboratory was the Scientific Crime Detection Laboratory, established at the Law Northwestern University School in 1930. His first director was Calvin Goddard, who had been particularly appreciated by the jury of the trial for the 'Valentine's massacre' for his work on the identification of firearms ".

What did Goddard do?
"Goddard developed the comparator microscope, revolutionizing the examination of bullets, cartridges and other items. Edgar Hoover, who was the head of the US Bureau of Investigation, immediately realised the importance of the scientific knowledge in criminal investigations, and sent Special Agent Charles Appel to Chicago to study with Goddard; he then opened the laboratory of the Bureau in 1932 which is now the current FBI Laboratory ".

Why science can help ascertain the truth during crime investigation?
“A crime scene hosts a plethora of traces left by the offender; their competent detection and interpretation can only be achieved by those who have had appropriate scientific training. The offender can also leave traces on the victim and traces of the victim and the crime scene can be found on the criminal himself. Edmund Locard first described these exchanges in 1920 and they are known as the 'exchange principle', according to which "every contact leaves a trace ".

How should the scientific investigation specialist act?
“The specialists do not limit their work to looking for the traces but has to subsequently make a competent interpretation underpinned by solid and proven science as well as reporting to the Judge in layman terms. The literature, with Dupin and Holmes and television, with series such as CSI, NCIS, have contributed to the popularity of forensic science, causing in the past years a real 'CSI effect.

What do you mean?
CSI effect can be detrimental in a court case by seeding wrong preconceptions in the jury's mind “This phenomenon on one hand promoted the study of scientific subjects but also led to incorrect information about forensic science capabilities and the manner in which scientific investigations must be conducted. The characters of TV dramas show tools that do not exist, they use inapplicable methods and reach scientifically unsustainable conclusions, yet their adventures thrill millions of spectators all over the world. It is, therefore, necessary to continuously update scientific knowledge and communication skills to manage expectations.

What does scientific information tell us?
"Scientifically underpinned forensic evidence is not more reliable and credible than non scientific evidence (for example an account from an eye witness), they are only written in a different language. To understand a witness who speaks a foreign language, the judge needs a translator. To understand and explain the meaning of a DNA trace, the judge needs a specialist who knows biology and statistical analysis. For making visible and studying a latent fingerprint the judge needs a specialist who knows chemistry. To understand when a victim died or what is the cause of an injury forensic pathology and toxicology are essential".

What is the contribution from forensic science in cases such as the Beirut explosion?
"A good example of how we can communicate effectively the scientific and technical information is the study of the explosion that devastated Beirut on 4 August 2020. The study of the videos of the fire and the subsequent explosion allowed the interpretation of some tale telling signs, such as the change of the color of the fumes, thanks to the underpinning scientific knowledge. This is not always possible. In most cases, events that occurred in the absence of eyewitnesses and video recordings are investigated. This is why it is essential to develop new technological tools able to 'read' the traces on the scene of the crime faster and more effectively".

How?
"The RISEN project intends to develop hypertechnological sensors to be used on the scene of crime. The information collected will be provided to investigators and to the Judge using augmented reality techniques."

RISEN Dissemination activities

The RISEN Consortium is organising the **"1st RISEN Workshop on New trends in Crime Scene Investigations"** which will take place on Friday, **8th October 202**1 (virtual event).

The Workshop aims 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 is to introduce the many challenges that forensic practitioners have to face during CSI and how to overcome these challenges.

Moreover, it will provide you with 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 will be 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 in-situ CSI.

Registration, flyer and Agenda of the event, is online, please visit the RISEN Website https://www.risen-h2020.eu/

FACTS AND FIGURES

Total Budget: € 6’995’876.25
Start date: July 1st, 2020
Duration: 48 months

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The RISEN Project is a collaboration between: