



Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations

D9.5 - S&R Exploitation and Innovation MGT planning

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Executive Summary

In the past years, there has been tremendous progress in the field of Search and Rescue area of activity; several successful projects have proven the benefits of autonomous vehicles, robots, smart clothing, DSS, Augmented Reality in assisting the efforts of first responders to natural or manmade disasters. However, the large variety of cooperative applications have been designed for different goals, stakeholders or specific settings / environments and have been developed on a silo-based approach and deployed independently from each other, serving however, at higher level, similar goals and functionalities for the end-user. Scalability, common operational framework, decentralization and maximum user inclusion are some of the most important properties that a technical and commercial successful solution must provide.

Search and Rescue (SnR) aims to design, implement and test through a series of large-scale pilot scenarios a highly interoperable, modular open architecture platform for first responders', a governance model designed to operate more effectively, and its architectural structure to allow easy incorporation of next generation R&D and COTS solutions, support a unified vision of the EU role and provide a common framework to assess needs and integrate responses for first responders.

The present report, titled D9.5 Exploitation and Innovation MGT planning, aims to establish a structured, yet flexible mechanism and related processes, which will penetrate all project's activities throughout the entire project's lifetime, in order to ensure that high levels of innovation are maintained, as expected and described in the project's grand. The ambitious objectives of SnR are placed within the complex landscape of Search and Rescue research in Europe, currently co-shaped by several actors, stakeholders, other research projects and policies. It is therefore of paramount importance that a large-sized project, with the cooperation of 29 partners of diverse backgrounds (industry, research, policy, operations), coming from 13 EU-member states requires a coordination and monitoring of all its activities, with a view of constant innovation in all its activities.

To ensure that goals of SnR do not lose relevance, a detailed plan for constant monitoring of the project targets is required. The report describes the Exploitation and Innovation MGT planning, which is comprised by a detailed analysis of previous and ongoing research and innovation activities in the Search and Rescue deployment field at the EU level, the Key Innovation Elements in SnR as well as those deliverables of the project that have a high innovation potential and will be closely monitored during the course of the project. It also provides a framework for assessing innovation throughout the course of the project, with a set of specific Innovation Metrics, related to the Key Innovation Elements of the project.

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1 Approach to Innovation

For the benefit of all partners, with varying backgrounds and different objectives within SnR project, as well as for the benefit of a structured approach towards effective innovation management at project level, a clear definition for innovation is needed and provided hereafter.

Innovation: The definition of innovation adopted in the present report is "The act of introducing a new device, product or method for application to commercial or practical objectives. Invention may or may not be needed, since innovation may include the introduction and use of known ideas and solutions in a new context"ⁱ.

Innovation Management: The definition of innovation management adopted herein is "The way that an organization and its members manage their innovation activities, including processes and structures for monitoring and controlling of innovation"ⁱⁱ.

2 Motivation - Providing Context on SnR Innovation

2.1 The Search and Rescue Research Project

The SnR project will design, implement and test through a series of large-scale pilot scenarios a highly interoperable, modular open architecture platform for first responders 'capitalising on expertise and technological infrastructure from both CONCORDE and IMPRESS FP7 projects. The governance model of SnR will be designed to operate more effectively, and its architectural structure will allow to easily incorporate next generation R&D and COTS solutions which will be possibly adopted in the future disaster management systems. The Model will also support a unified vision of the EU role and will provide a common framework to assess needs and integrate responses. The framework will enable supportive approach using a wider range of decisional support features and monitoring systems and will also give to first responders an effective and unified vision of (a) the dynamic changes going on during event's lifetime and (b) the capabilities and resources currently deployed in the field.

2.2 Innovation Management in SnR

Innovation Managements as part of WP9 includes several activities crucial to the success of the Project. The first activity is the development of the current document which contains an innovation management structure to provide the managerial tools, structure and capabilities required for guiding the first responders, academic and software partners based on the solution roadmap and verified prototypes. The second step is the set-up of an innovation management steering committee and a capability development program that will lead to the development of the reference Integrated Technology Roadmap of the S&R Solution. The roadmap will enable users to adopt the implementation, tools and techniques from the project, to use the platform and obtain maximum benefit from the solution. The second phase of innovation management and capability development will see the setup of a steering committee with leaders from the different policy stakeholders that will assess the innovative solutions, processes and methodologies developed through key indicators, the results from the pilot applications and provide assistance and guidance to the project partners for transforming these solutions and processes to actual marketable results.

2.3 Document Structure

- An Executive Summary is provided at the beginning of the present report.
- Section 1 provides a foreword on innovation and innovation management, by defining the terms to maintain a common understanding throughout the project lifetime.
- Section 2 introduces innovation management within the context of the SnR project and its necessity as well as provides an overview of the structure of this report (present section).
- Section 3 presents the Innovation Strategy plan, including the approach for innovation management adopted in the SnR project, an assessment of the policy and research projects' landscape in Europe, the Key Innovation Elements defined in SnR and a list of the deliverables of SnR with a high innovation potential.
- Section 4 presents the framework for the assessment of innovation throughout the lifetime of the SnR project.
- References and Annexes are included at the end of this report.

3 Innovation Strategy Plan

3.1 Innovation Management Strategy

As per the definition of innovation management adopted in SnR, innovation management includes processes and structures for monitoring and controlling of innovation within the SnR projectⁱⁱⁱ and aims to manage and control activities that, starting from end users' needs^{iv}, intend to continuously identify and check new ideas with the final objective of developing new products or services which can satisfy these needs.

The activities of the Innovation management strategy within SnR will include the following processes:

- Definition and dynamic management of the innovation management approach
- Understanding of the landscape, including market, key stakeholders, trends, technologies, needs and opportunities
- Continuous monitoring of the landscape
- Assessment of the innovation potential of research results
- Liaise with Innovation Management Committee and take corrective measures if needed, to ensure that market needs are best met

The innovation management strategy will be implemented through activities, which are planned in a way that allows their execution in iterations, so as to allow being continuously in line with ongoing evolution at market, technological and non-technological level. Having defined the innovation management strategy, the activities to implement, include a very good understanding and continuous (throughout the whole lifetime of the project) monitoring of the general Search and Rescue landscape/domain, in terms of market needs developments and opportunities. This monitoring of external activities allows making comparative assessment between these and the developments within the project to ensure that remain relevant within the global context and preserve always a high degree of innovation. The interaction with the Innovation Management committee with its external actors bringing their own unique perspective will ensure a continuous adaptation of innovation plans so they will remain relevant.

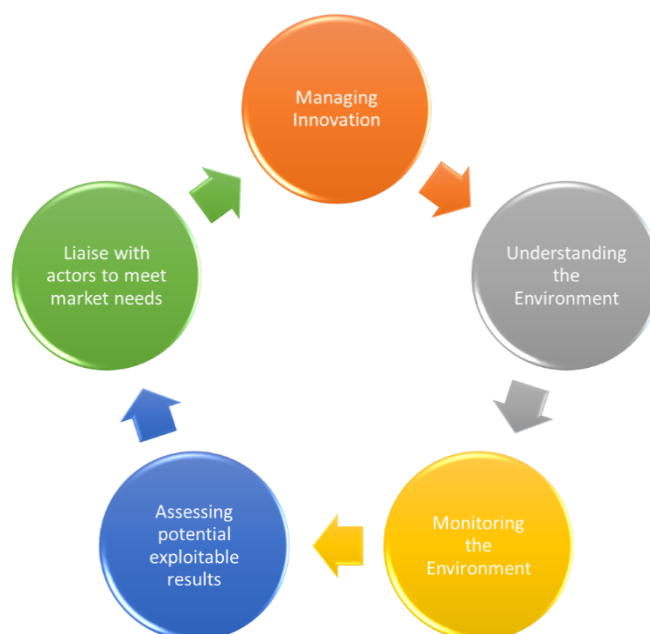


Figure 3-1: Schema of the SnR Innovation Management Strategy activities

Innovation management within SnR is the primary responsibility of the Dissemination, Exploitation Innovation Management Committee. According to the SnR Grant Agreement and DoA, the responsibilities of the Dissemination, Exploitation, Innovation Management Committee include:

- Establishment of processes to maximize exploitation of the results by SnR partners;
- Responsible for the identification of SnR innovations;
- Responsible for taking together with the Technical Management Team and the Exploitation Manager necessary actions to ensure favorable conditions for innovation and for the effective exploitation of innovations during and after the end of the project.

To achieve these goals and fulfil the responsibilities, the leading partner of Innovation of the SnR project together with the Dissemination, Exploitation Innovation Management Committee will:

- Define the Innovation Management strategy approach, plan all related activities and inform all project partners accordingly;
- Continuously monitor market, technology and policy trends in the Search and Rescue domain;
- Liaise with end user groups to acquire their feedback on the usability of the services to be offered;
- Inform at a regular basis the SnR consortium partners about emerging trends on the above. This will be done through the common project space and at innovation online meetings;
- Continuously monitor all major project activities related to the deliverables with high innovation potential (Table 3-3: Description of Key Innovations);
- Continuously liaise with Work Package leaders to assess the innovation level of the activities executed therein against the Innovation management plan (present report). This will be done also collectively for all Work Packages, due to the high degree of interconnectivity and interdependency of the project activities;
- Assess the level of innovation at project level, utilizing Innovation Metrics, a set of performance indicators, which are related to the Key Innovation Elements of the project (Table 3-3: Description of Key Innovations Table 3-4: Deliverables of High Innovation Potential);
- Report at M12 on the innovation management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the First Period Report;
- Report at M22 on the innovation achievements related to innovation at project level, within the framework of the D9.6 Business Plan first Version;

- Report at M36 on innovation as well as on the major achievements related to innovation at project level, within the framework of the D9.7 Business Plan Final;
- Provide inputs to business, exploitation and market roll-out plans to be developed within the framework of WP4, WP5 and WP6 ;
- Provide inputs to the strategic agenda for innovation and deployment of the SnR Governance Model within the framework of WP1;
- Ensure the innovation level during all meetings, workshops and consultations that will take place during the project;
- Provide support during potential introductions of SnR commercially exploitable results to third parties or candidates for technology transfer.

1.1.1. The Innovation Management Steering Committee

In the second phase of Innovation and Exploitation Management there is the mandate of creating the Innovation Management Steering Committee, a coalition of leaders from across the stakeholder organizations and entities that will guide and oversee the entire journey of innovation for the Search and Rescue Project. The members of the Steering Committee are selected from external organisations to the project participants but with interest critical to ensure the relevance and usefulness of SnR activities and results.

They will come from organisations such as:

1. Practitioner Organisations: First responders (fire fighters, law enforcement, emergency services, etc.), civil protection units and civil society organisations / NGOs, and networks
2. Scientific and Research Community: Universities and research centres having a focus on disaster risk and crisis management, scientific and research work can be developed in other institutions, either public or private: Associations in the field of crisis management, think tanks, R&D departments of private companies, etc. Additionally, institutions that participated in related EU projects
3. Private Sector: Insurance Companies, Manufacturers of Safety Equipment
4. Public Bodies: EU, National and Local Governments

They will be responsible for driving the change process that will move the project towards a culture that supports and sustains innovation; constantly monitoring it to make sure that it stays on track.

To facilitate the differentiation between the two committees and clarify their roles, the following table is presented.

Dissemination, Exploitation & Innovation Management Committee	Innovation Management Steering Committee
Internal Committee created by the Consortium Members	External Committee created from stakeholders with interest in the project outcomes
Create a vision for innovation	Validate the innovation vision
Develop the innovation strategies	Assess and monitor the innovation strategies
Design and implement innovation processes	Follow these processes

Design and implement innovation metrics	Utilise these metrics to measure outcomes
Organise and participate in dissemination events to promote the project outcomes	Suggest how to apply resources to innovation teams
Link innovation to exploitation	Develop rewards and recognitions for innovation teams
	Liaise with external actors to further promote the project outcomes

Table 3-1: Differentiating Between Committees Focused in Innovation

The Innovation Management Steering Committee members will be appointed from persons nominated by the consortium members from their respective fields of operation. The Committee will have no more than nine members in order to be functional and efficient. The number of nominations, the number of appointees and the maximum number of members selected is presented below. The selection process is depicted in 4.2.

	Partners	Number of Nominations	Maximum Number of Members in the Committee
Academic Community	   	8	3
Research Organisations	 	5	2

NGOs		12	4
Public Policy		4	3
Industry		11	4

Table 3-2: The selection process of Innovation Management Steering Committee members

The nominations for the appointment of the Innovation Management Steering Committee by the partners is expected by the end of Month 20 of the project and its formation by the end of Project Month 21. Once formed they will be meeting (mainly through Videoconference) at appointed dates and the conclusions of these meetings will be disseminated to the project actors for action.

3.2 Analysis of the Search and Rescue landscape in Europe

3.2.1 EU Search and Rescue Policy Setting

EU complements, supports, coordinates national action, and promotes cross-border cooperation on protecting people, property, environment, and cultural heritage against multiple threats. Under the EU Civil Protection Mechanism, Member States and participating countries regularly exchange information on disaster risks, run exercises together and pool rescue teams and equipment that can be rapidly mobilised when a disaster overwhelms any other country in the world^v.

For this reason, the Commission regularly prepares and publishes overviews of natural and man-made disaster risks that the EU faces. To address these risks a Disaster Risk Management Knowledge Centre has been established to provide EU Member States and the disaster risk management community with an online repository of disaster-related data, research and project results and access to a range of networks and partnerships^{vi}. It integrates existing scientific multi-disciplinary knowledge and co-develops innovative solutions for existing needs. Activities of the EC Disaster resource Management Knowledge Center support the translation of complex scientific data and analyses into usable information and provides science-based advice for DRM policies^{vii}.

Translating the scientific results and policy recommendations to action comes in two distinct but complimentary ways. First by offering peer reviewing of disaster risk management and civil protection arrangements^{viii} to provide a country or a region with a unique opportunity to reflect on its readiness to cope with natural and man-made hazards and identify ways of strengthening its broader prevention and preparedness system and secondly with advisory missions that offer tailor-made support and advice on specific needs and problems^{ix}. Experts from EU Member States and Participating States to the Mechanism are deployed upon request from a national government to support authorities^x. Finally enhancing International Cooperation mainly through the Sendai Framework for Disaster Risk Reduction 2015-2030 where although the European Commission is not a signatory to the Sendai Framework, it played a leading role in the international negotiations, supports EU Member State signatories and third countries in implementing the Agreement, and works to ensure EU action is coherent with the global agenda^{xi}.

During the revision of the Union Civil Protection Mechanism, the creation of a Union Civil Protection Knowledge Network was introduced to bring together civil protection and disaster management experts and organisations, increase knowledge and its dissemination within the UCPM, and support the Union's ability and capacity to deal with disasters^{xii}.

The Knowledge Network, which will be officially launched on the 7th of December 2021, will support experts, practitioners, policy-makers, researchers, trainers and volunteers at every stage of the disaster management cycle through networking, partnerships, collaborative opportunities, and access to expertise and good practices. It will facilitate the active participation of knowledge holders and foster an inclusive approach to ensure that the Knowledge Network addresses key concerns and needs of its members. It will also connect and strengthen cooperation with existing initiatives, such as the DRMKC and relevant international and national structures to increase cooperation, exchange of knowledge, and further expand networking opportunities.

The Civil Protection Knowledge Network will play three roles. As a Knowledge Broker, the network will make knowledge more accessible to the civil protection and disaster management actors, offering them a space to learn, work and grow together. As a Partnership Facilitator, it connects a variety of stakeholders active at different levels, from local to international, from governmental to non-governmental, from the political to the scientific and operational and financing joint and cross-sector initiatives. It also acts as an Innovation Catalyst by stimulating research and facilitating the introduction and uptake of new technologies and processes in the field of civil protection and disaster management. Therefore, the Union Civil Knowledge Network is identified as a key stakeholder on the EU landscape for the promotion of the project outputs

3.2.2 Main EU research initiatives in the domain of Search and Rescue that form the basis for SnR Innovation

Innovative research activities in the domain commenced since FP5 in early 2000 with the Tri band safety beacon^{xiii} project aimed to research and develop a prototype of rescue beacon for helicopters, with a tri band emitter. The PELOTE project (Building Presence through Localization for Hybrid Telematic Systems^{xiv}) aimed to design novel methods for building presence through integrating and co-ordinating autonomous collaborative entities in a telematic application, comprising nonliving systems and human actors. One of the first projects to address the use of UAVs was the CAPECON project (Civil UAV application and economic effectiveness of potential configuration solutions^{xv}) with the aim to advance the utilisation of safe and low-cost Unmanned Air Vehicles (UAVs) in the civilian commercial sphere. Utilising robots in SnR operations was the objective of GUARDIANS (Group of unmanned assistant robots deployed in aggregative navigation supported by scent detection^{xvi}) funded in 2006 under Fp6-IST aiming to develop a swarm of autonomous robots applied to navigate and search an urban ground. The project's central example was an industrial warehouse in smoke, as proposed by the Fire and Rescue Service. Also, in 2006 under the same program Fp6-ICT the commission funded Project STARRS (Sensor for terrestrial and Airborne Radio-transmitter rescue search^{xvii}) focused on the design and development of technology for the improvement of environmental risk/crisis management, especially in search and rescue operations (to detect and locate victims' position with a good accuracy as well as to allow alert broadcasting). Under the FP6-SME funding initiative the Commission funded RADIOTECT (Ultra Wideband Radio application for localisation of hidden people and detection of unauthorised objects^{xviii}). The SMEs intended to sell the products to the security and rescue markets. In 2013, under FP7, the COSMIC project (Contribution of Social Media in Crisis management^{xix}) identified the most effective ways to utilise new information and communication technologies (ICTs) in crisis situations for the protection of ordinary citizens. Along the same lines and in the same funding period and program (FP7 -2013), The Athena Project^{xx} brought together major user communities with world leading experts in crisis management and experts and technology developers of mobile and social media use and development. The ISAR+ (Online and Mobile Communications for Crisis Response and Search and Rescue^{xxi}) project (2007-FP7-Security) aimed to research and develop guidelines and an associated platform that, in emergencies or crises, enabled citizens using new mobile and online technologies to actively participate in the response effort through the bi-directional provision, dissemination, sharing and retrieval of information essential for critical PPDR intervention, in search and rescue, law enforcement and medical assistance. In the field of integrating various sensors for SnR,

one of the first R&D initiatives was Project ICARUS (Integrated Components for Assisted Rescue and Unmanned Search operations^{xxii} - Fp7-Security 2012) which proposed to equip first responders with a comprehensive and integrated set of unmanned search and rescue tools, to increase the situational awareness of human crisis managers and to assist search and rescue teams for dealing with the difficult and dangerous, but life-saving task of finding human survivors.

In HORIZON Research Program the Commission funded a series of projects building on and expanding the results of previous Programs.

In the field of Robotics, several projects were funded, some of them are presented. Project SmokeBot (Mobile Robots with Novel Environmental Sensors for Inspection of Disaster Sites with Low Visibility - 2016 HORIZON)^{xxiii} aimed to deliver software and hardware components which facilitate robot systems to perform under harsh conditions of smoke, dust or fog. Project CENTAURO (Robust Mobility and Dexterous Manipulation in Disaster Response by Fullbody Telepresence in a Centaur-like Robot^{xxiv} - 2017 HORIZON) aimed at developing a human-robot symbiotic system where a human operator is telepresent with its whole body in a Centaur-like robot, which is capable of robust locomotion and dexterous manipulation in the rough terrain and austere conditions characteristic of disasters. The Project BADGER (RoBot for Autonomous unDerGround trenchless opERations, mapping and navigation^{xxv} -HORIZON 2018) aimed to design and develop the BADGER autonomous underground robotic system that can drill, manoeuvre, localise, map and navigate in the underground space, and is equipped with tools for constructing horizontal and vertical networks of stable bores and pipelines. CURSOR (Coordinated Use of miniaturised Robotic equipment and advanced Sensors for search and rescue OpeRations^{xxvi} - HORIZON 2019) aims at developing new and innovative ways of detecting victims under debris. This includes the coordinated use of miniaturised robotic equipment and advanced sensors for achieving significant improvements in search and rescue operations.

In the field of UAVs we have Project AEROBI (AErial Robotic System for In-Depth Bridge Inspection by Contact^{xxvii} - HORIZON 2015), which adapted and integrated recent research results in low flying unmanned robots with arms, intelligent control in robotics, computer vision and sensing, in an innovative, integrated, low flying, robotic system with a specialised multi-joint arm that scanned concrete beams and piers in a bridge for potential cracks on the surface or concrete swelling or spalling. Project AEROWORKS (Collaborative Aerial Robotic Workers^{xxviii} - HORIZON 2015) consisted in a novel aerial robotic team that possesses the capability to autonomously conduct infrastructure inspection and maintenance tasks, while additionally providing intuitive and user-friendly interfaces to human-operators. MOBNET (MOBile NETwork for people's location in natural and man-made disasters^{xxix} - HORIZON 2016) aimed to design a Search and Rescue (SAR) system using UAVS for the location of isolated victims in the case of natural or man-made disasters such as earthquakes, hurricanes or large snowstorms. Project AirBorne (AErial RoBotic technologies for professiOnal seaRch aNd rescuE^{xxx} - (HORIZON 2018) develops at TRL8 a few selected robotic aerial technologies for professional SAR teams/associations with a specific focus on quick localization persons buried by avalanches.

In the field of Haptic Devices Human Machine interaction and training, indicative research initiatives are: I-React (Improving Resilience to Emergencies through Advanced Cyber Technologies^{xxxi} - 2016 HORIZON). I-REACT integrated existing services, both local and European, into a platform that supported the entire emergency management cycle. beAWARE^{xxxii} (2016 HORIZON) proposed an integrated solution to support forecasting, early warnings, transmission and routing of the emergency data, aggregated analysis of multimodal data and management of the coordination between the first

responders and the authorities. ANYWHERE (EnhANCing emergencY management and response to extreme WeaTHER and climate Events^{xxxiii} - HORIZON 2016) implemented a Pan-European multi-hazard platform providing a better identification of the expected weather-induced impacts and their location in time and space before they occur. This platform supported a faster analysis and anticipation of risks prior the event occurrence, an improved coordination of emergency reactions in the field and help to raise the self-preparedness of the population at risk.

SARA: Search and Rescue Aid using High Accuracy EGNSS^{xxxiv} (HORIZON 2018) builds up a semi-automatic system using Earth Observation data to preliminary detect suspect pontoons 'trajectories' (Surveillance) and supporting SAR operations based upon a deployable RPAS (Remotely Piloted Aircraft System) which is tightly coupled with a ship architecture through a cable (tethered flight): as soon as its function is needed, the aircraft flies from its home (a dedicated hangar on the top of the ship), and becomes a "virtual pylon" which elevates a VIS-TIR sensor (Visual Spectrum and Thermal Infrared); captured images are processed in real time by a local computer. Both RPAS and hangar are equipped with 2 high accuracy EGNSS receivers (i.e. Galileo ready) in order to provide the relative positioning between the hangar and the RPAS hovering on the target.

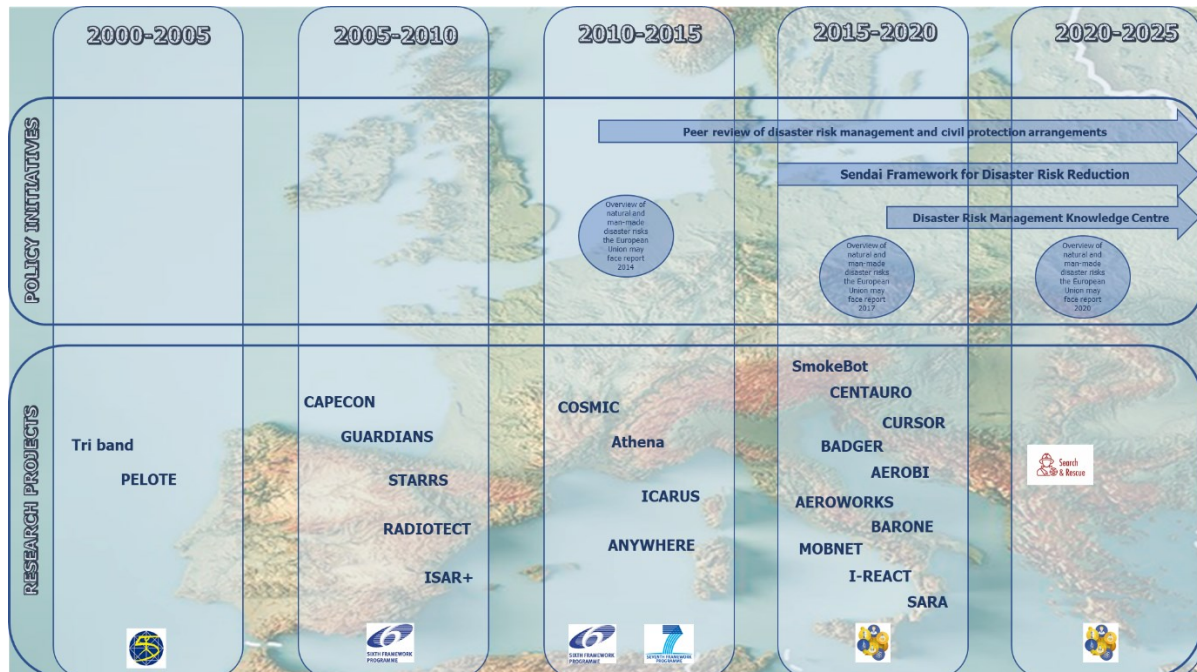


Figure 3-2: Search and Rescue Policy Initiatives and Research Activities

3.3 Key Innovations in Search and Rescue project

Search and Rescue project aims to establish an efficient synchronization framework managing the data, developed services and information flow between the different authorities involved in emergency management operations and the crisis managers (Rescue forces, Police, Fire-department, etc.). Ad hoc web portals and additions to stakeholders' systems and back-offices will provide a common, uniform and ubiquitous platform for collecting, analysing and sharing real time data from the sensors, drones and rescue robots for supporting management decisions. Federated security will enable access by different stakeholders to services provided by different stakeholders. Thus, SnR aspires to build a state-of-the-art framework that will integrate:

1. Advanced sensors, systems and procedures to obtain high level awareness capabilities
2. Secured data collection and information flow between the different authorities and agencies which are involved in the crisis/abnormal events management
3. Fusion of data from different sources and creation of a Common Situational Picture for supporting decisions of emergency and crisis management
4. A multi-tier architecture of information processing, the result of which will be accessible in a ubiquitous manner by all the actors involved

In this respect, several known barriers of technical and non-technical nature need to be overcome. The ways that will be followed and the solutions that will be adopted by SnR require a high level of innovation, to overcome these known barriers and to achieve the realization of the project's research objectives, namely:

- a) The introduction of a citizen-centric crisis response framework, methodology and a Governance model for stronger coordination between local/national and EU activities in the field of Search and Rescue
- b) Improving the EU Knowledge base
- c) Enhance Resource Availability
- d) Suggest new protective clothing and advanced wearables for all first responders that protects against multiple hazards

These will comprise also the key innovation elements of the SnR. The following table aims to provide an overview of the innovation elements of SnR. The key innovation elements are dynamic and therefore this table will be continuously updated during the course of the project, by monitoring the technological and market landscape of the Search and Rescue domain. Its current version presents the status as of Month 16 of the project (October 2021).

Id Number	Description of Key Innovation
Inn-1	Provision of the SnR products, services, policies and guidelines that address the Technical, Operational Business and Research outcomes as stated in the work programme
Inn-2	Bundling of the SnR products, services, policies and guidelines to distinguishable bundles to address different stakeholders and market segments
Inn-3	Collaboration of the various stakeholders' groups in the Search and Rescue domain using the SnR platform, roadmap, guidelines and services

Id Number	Description of Key Innovation
Inn-4	Large-scale deployment of SnR services in complex environments, paving the way for large-scale deployment in cities, regions and countries beyond the SnR consortium
Inn-5	Utilisation of commonly accepted frameworks, including Cost-Benefit-Analyses, and Operational Impact Assessment
Inn-6	Contribution to and use of standards in the domain of SnR through the implementation of the SnR Governance Model across Europe
Inn-7	Support of evidence-based decision making to relevant decision makers and key stakeholders, through the provision of roadmaps, guidelines and training
Inn-8	Development of viable business models for large-scale and sustainable deployment
Inn-9	Support of open innovation and entrepreneurship

Table 3-3: Description of Key Innovations

3.4 Deliverables of High Innovation Potential

The project deliverables, which have a high potential for innovation are listed in the table below. These deliverables will be monitored with particular attention at all stages of their development by the partners responsible for Innovation Management and the Innovation Management Committee, to ensure that the level of innovation is maintained at high level

Deliverable Number	Description of Deliverable
D1.1	Report on user requirements, existing tools and infrastructure
D1.2	Report on the functional specifications of SnR
D1.3	Definition, evaluation and refinement of the SnR CM governance model
D1.4	Establishment of SnR Concept of operations
D1.6	Report on the functional specifications of S&R, V2
D4.8	DSS Validation

Deliverable Number	Description of Deliverable
D5.3	Testing and validation of the RESCUE MIMS
D5.4	Testing of RESCUE MIMS on-board robotic platforms and drones
D6.3	Presentation and analysis of the designed SnR interoperability framework
D7.1	SnR extensive service catalogue
D7.4	Adapted SnR components and services
D7.6	Integrated SnR platform 2nd version
D7.10	SnR platform Test Cases and overall system evaluation results
D8.7	SnR Evaluation Framework
D8.9	SnR Pilot Implementation and Evaluation Report Final version
D9.7	SnR Business plan final

Table 3-4: Deliverables of High Innovation Potential

4 Search and Rescue Assessment of Innovation Framework

4.1 Assessment Framework

There are 4 major indicators to measure innovation in the project^{xxxv} :

- Technological Novelty which refers to the extent to which an innovation advances the technological performance frontier more significantly than the existing technological path and constitutes a major transformation of existing products services, methodologies, guidelines and protocols;
- Market scope relates to the extent to which an innovation has the potential to create a new market and introduces a different set of features compared to existing products and services that is attractive to a new class of customers;
- Ecosystem embeddedness that refers to the extent to which the development and commercialisation of an innovation is embedded in a community of organisations and individuals who can affect or are affected by the innovation, such as suppliers, customers, and other stakeholders;
- Innovation readiness corresponds to the extent to which an innovation achieves a satisfactory level of technological maturity and is likely to be successfully commercialized.

The objective of assessment of innovation throughout the entire lifetime of the SnR project is to have means of verification that the SnR research and innovation activities are of consistently high level of innovation, valid, relevant within the broader landscape and context, and of course aligned with the objectives of the project with respect to innovation along the lines of the four innovation indicators presented above. To do so, the framework for the assessment of innovation in SnR will include a set of Key Innovation Elements (as described in the previous section), which will be continuously monitored throughout the project's duration. Monitoring of these Key Innovation Elements will allow to have an overview of the impacts of SnR at technological and market level. It will also allow taking corrective measures, in case of deviations from strategic objectives and innovation related goals.

This approach relies upon the innovation management strategy defined herein and it is schematically depicted next.

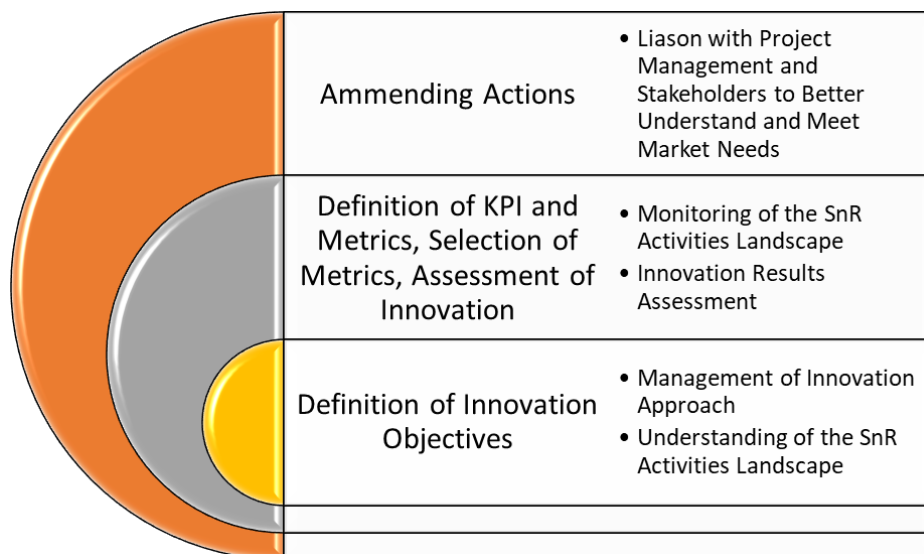


Figure 4-1: Schema of the Innovation Management assessment framework

The proposed assessment framework using the metrics of 4.3 will be utilised:

1. to determine the successful or not transition to the desired Technology Readiness Level as presented in the SnR proposal^{xxxvi} for the tangible technological results of the project (presented in the table 5 below).

Equipment	Present TRL	End TRL
Smart Glasses & AR Helmets	4	6
Emergency communication app	5	7
Advanced Augmented Reality (AR) technologies	3	5
Wearable GPS Tracker	4	6
Wearable ECG, EMG (wearable)	6	7
Wearable Strain sensors (wearable)	5	7
Emergency response health condition monitoring device	4	6
Radiation sensors (wearable)	5	7
Rescue drones	9	9
AI services on top of rescue drones	6	7
Rescue Robots & Autonomous vehicles	6	7
Chemical sensors	4	6
CONCORDE EMS & Associated module / services	5	6
Decision Support System (DSS)	4	6
Training through AR/VR	5	6
Smart textile professional uniform	4	6
Rescue system for children	4	6
3D Mixed Reality Command Centre	3	6

Smartwatch	3	5
Volunteer registration and operationalization application	4	6

Table 4-1: SnR proposed technological equipment, TRL advancement

2. To determine the success of the non-technological results such as the adoption of the citizen-centric crisis response framework, methodology and a Governance model for stronger coordination between local/national and EU activities in the field of Search and Rescue

4.2 Innovation Processes

4.2.1 The selection process of Innovation Management Steering Committee members

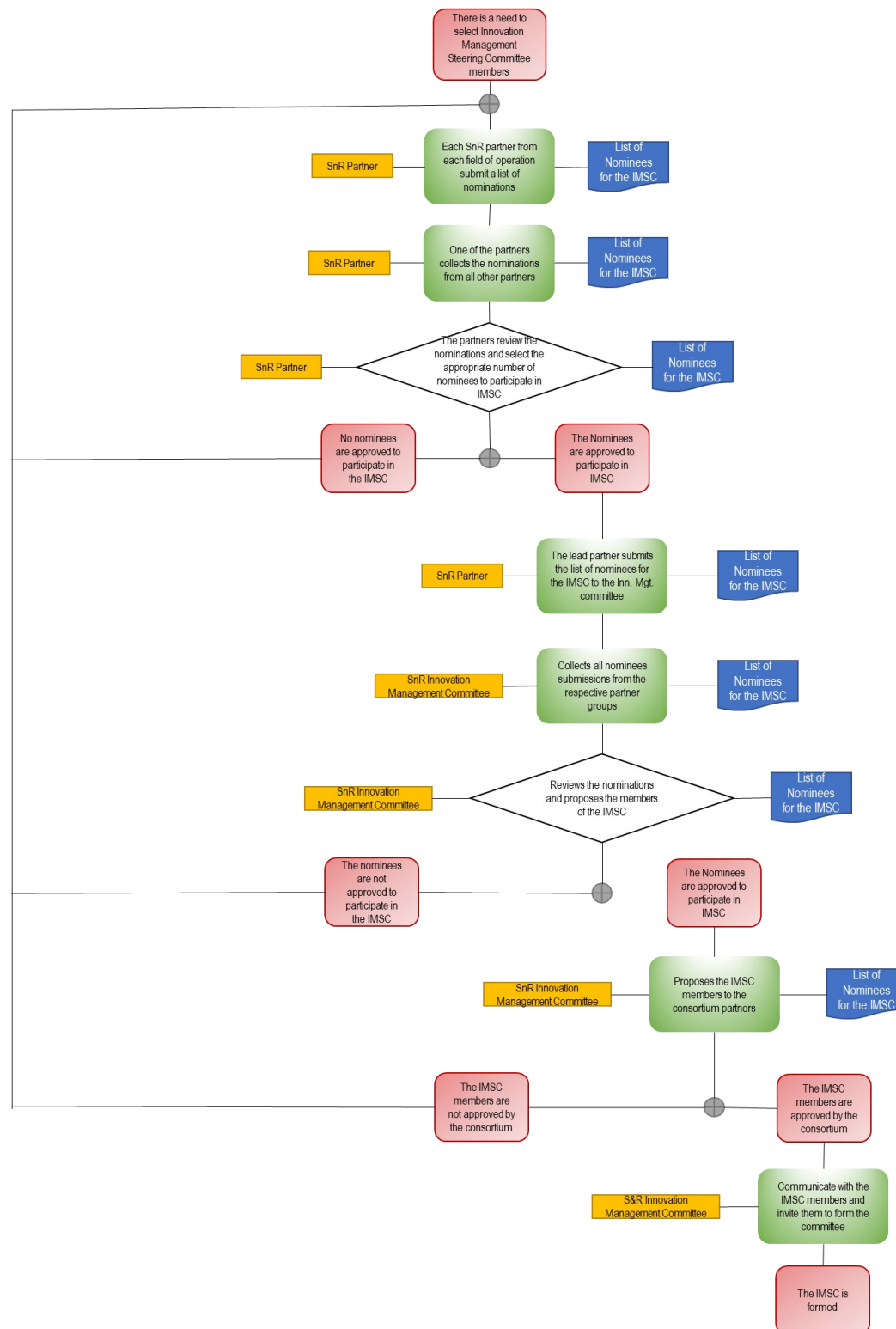


Figure 4-2: Selection of Innovation Management Steering Committee members Process

4.2.2 New Innovation Capture and Assessment Process

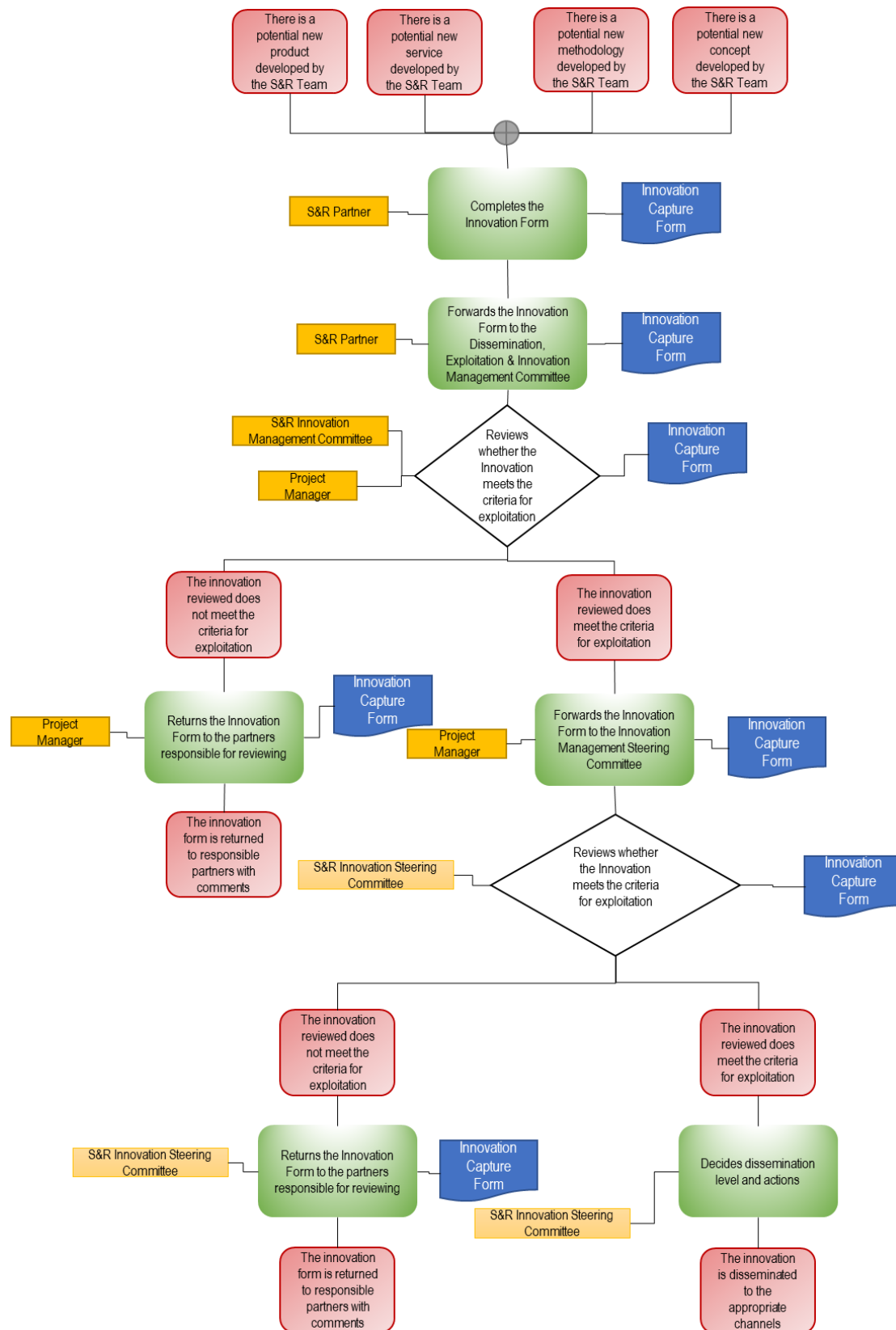


Figure 4-3: Innovation capture and assessment process

4.2.3 Innovation Identification and Evaluation

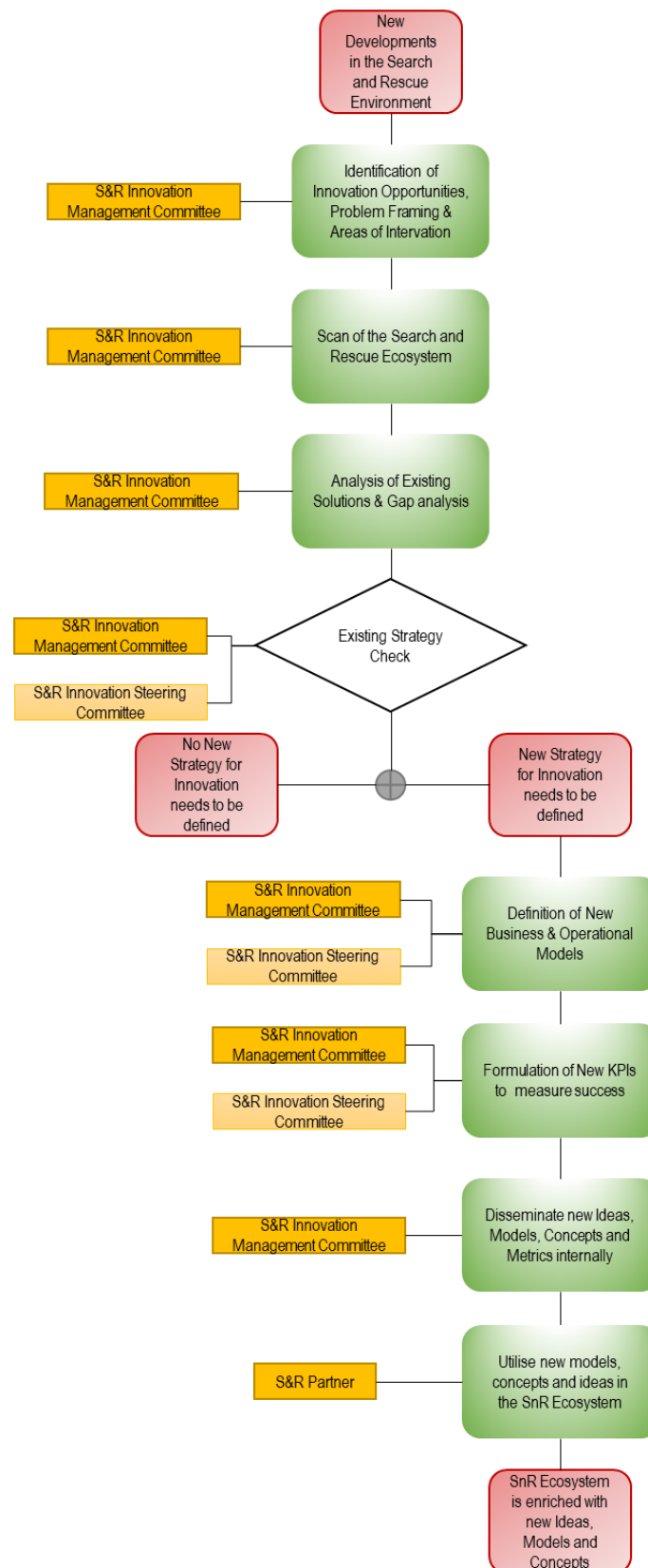


Figure 4-4: New Innovation Identification and Evaluation

4.2.4 New Product/Solution/Concept/Methodology Development Process

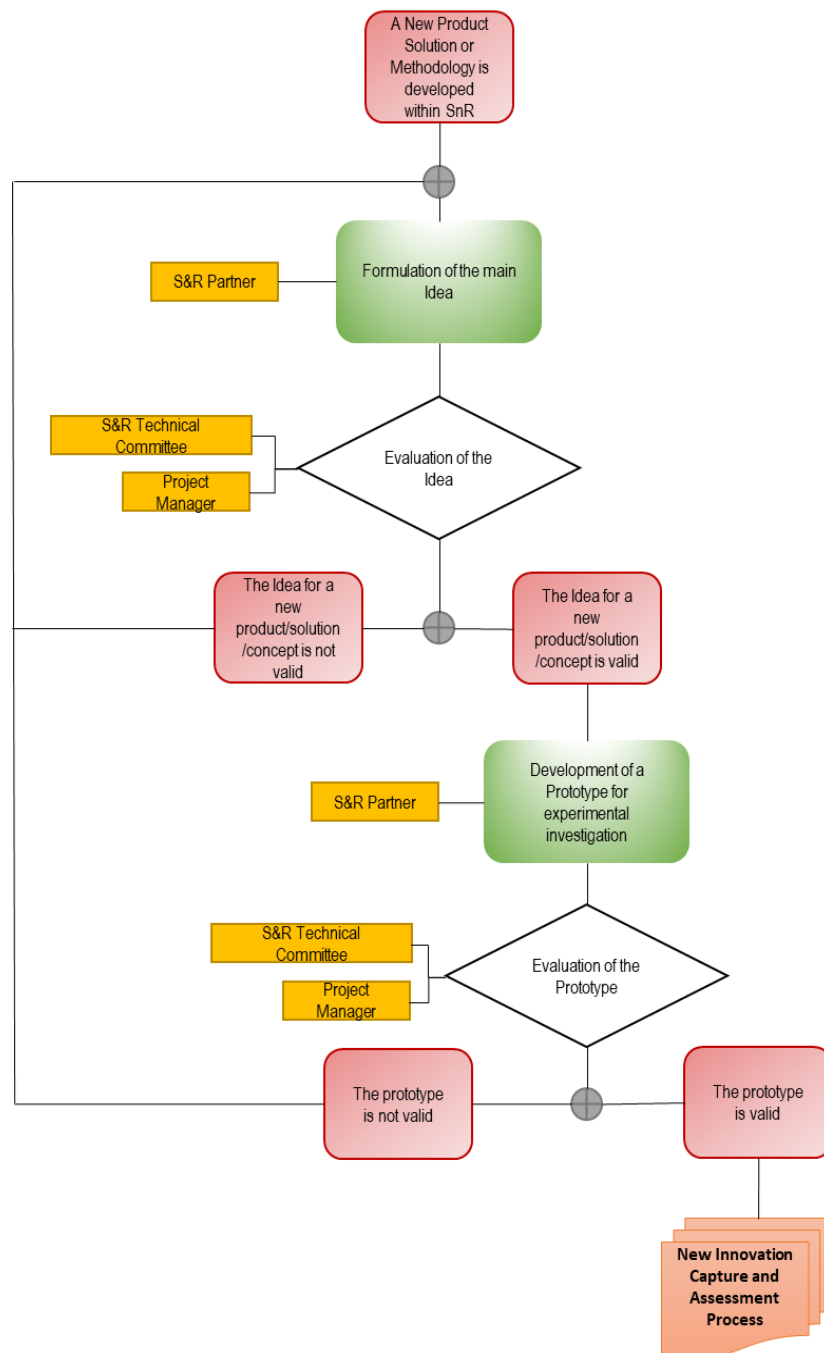


Figure 4-5: New Product/Service/Methodology/Concept Process

4.3 Innovation Metrics

A list of innovation performance indicators, herein named Innovation Metrics (IM), has been defined and will be utilised during the course of the SnR project. These Innovation Metrics are presented in the following table, including the relation to four major innovation indicators, which have been presented in paragraph 4.1.

IM ID	Innovation Metrics Description	Association to Key Innovation	IM Category	IM Target Value
IM-1	Number of scientific publications and conference/congress presentations	Inn-5 Inn-6 Inn-9	Ecosystem embeddedness	>/ 20
IM-2	Number of new tools, systems, and services supporting SnR services distribution	Inn-1 Inn-2 Inn-8	Technological Novelty, Market scope, Innovation readiness	>/10
IM-3	Number of new architectures and deployment platforms supporting the large-scale deployment of SnR in Europe	Inn-3 Inn-4	Technological Novelty, Innovation readiness	>/1
IM-4	Number of commonly accepted methods and tools for impact assessment of SnR services	Inn-5 Inn-6	Ecosystem embeddedness, Innovation readiness	>/3
IM-5	Number of EU projects with which cooperation is established	Inn-3 Inn-6	Market scope, Ecosystem embeddedness	>/5
IM-6	Number of non-EU projects with which cooperation is established	Inn- 3	Market scope, Ecosystem embeddedness	>/3
IM-7	Number of established and functional stakeholders' partnerships	Inn-6 Inn-8	Ecosystem embeddedness	>/5
IM-8	Contributions to standards (new standards, enhanced/revised existing standards), methodologies,	Inn-1 Inn-2	Ecosystem embeddedness, Innovation readiness	>/3

IM ID	Innovation Metrics Description	Association to Key Innovation	IM Category	IM Target Value
	policies, and processes at a European level and/or National level			
IM-9	Number of new business models developed and adopted for large-scale deployment	Inn-8 Inn-9	Market scope, Innovation readiness	>/2
IM-10	Number of new commercially available and exploitable products	Inn-1 Inn-4 Inn-2 Inn-5 Inn-8	Market scope, Innovation readiness	>/3
IM-11	Number of events organised to promote the use of SnR solutions to third parties	Inn-3 Inn-8	Ecosystem embeddedness, Innovation readiness, Market scope	>/10

Table 4-2: Innovation Metrics

These metrics will be measured by utilising a set of data derived from the project's deliverables presented in paragraph 3.4. The results will be presented in the project's website and constantly will be updated to reflect the success of the SnR innovation efforts.

Annex I: Innovation Form

Innovation Capture Form

Partner:

Work Package:

Innovation Details	Description
Provide a short description explaining what the innovation is	
Provide a technical description of the innovation	
Problem(s) addressed by the innovation	
Existing solutions to the problem(s) that you are aware of and consider to be closest to the new innovation	
Key aspects of the invention which make it novel and demonstrate its advantages over the existing solutions	
Potential commercial (or academic) application (products, processes, services, or research tools) based on the invention	
Companies you think might be interested in using, developing or marketing this invention	
Do you plan to publish any papers on your innovation and in what medium/publication	
Prior Research	

Innovation Details	Description
Please list relevant references from the scientific literature Please list the results of any patent search you have conducted (google.com/patents)	
Has any public disclosure of the invention occurred already, without the protection of a Non-Disclosure Agreement	If Yes, please provide details:
Is any disclosure pending?	If Yes, please provide details:

Is the innovation linked to any of the following whether past, present or currently under negotiation?

	YES	NO
material transfer agreement(s)		
license agreement(s)		
personal consultancy(s)		
provision of equipment		
open-source software license		
If Yes to any of the above, please provide details		

(use separate sheet if necessary)

Annex II: References

- ⁱ Melissa A. Schilling Strategic Management of Technological Innovation New York University retrieved from <https://www.ericshaver.com/the-many-definitions-of-innovation/>
- ⁱⁱ Melissa A. Schilling Strategic Management of Technological Innovation New York University retrieved from <https://www.ericshaver.com/the-many-definitions-of-innovation/>
- ⁱⁱⁱ Melissa A. Schilling Strategic Management of Technological Innovation New York University, Introduction, p5.
- ^{iv} SnR Project Deliverable D1.1 Report on user requirements, existing tools and infrastructure
- ^v https://ec.europa.eu/echo/what/civil-protection_en
- ^{vi} https://ec.europa.eu/echo/what/civil-protection/european-disaster-risk-management_en
- ^{vii} <https://drmkc.jrc.ec.europa.eu/>
- ^{viii} https://ec.europa.eu/echo/what-we-do/civil-protection/peer-review_en
- ^{ix} The European Commission. Cohesion policy: preventing risks, available at <https://cohesiondata.ec.europa.eu/stories/s/Cohesion-policy-preventing-risks/j9ce-3mtn/>
- ^x Overview of natural and man-made disaster risks the European Union may face https://ec.europa.eu/echo/sites/default/files/overview_of_natural_and_man-made_disaster_risks_the_european_union_may_face.pdf
- ^{xi} The Sendai Framework https://ec.europa.eu/echo/partnerships/relations/european-and-international-cooperation/sendai-framework-disaster-risk-reduction_en
- ^{xii} https://ec.europa.eu/echo/what/civil-protection/knowledge-network_en
- ^{xiii} TRI BAND SAFETY BEACON PROJECT <https://cordis.europa.eu/project/id/G4ST-CT-2000-00228>
- ^{xiv} Building Presence through Localization for Hybrid Telematic Systems <https://cordis.europa.eu/project/id/IST-2001-38873>
- ^{xv} Civil uav application and economic effectiveness of potential configuration solutions <https://cordis.europa.eu/project/id/G4RD-CT-2002-00795>
- ^{xvi} Group of unmanned assistant robots deployed in aggregative navigation supported by scent detection <https://cordis.europa.eu/project/id/045269>
- ^{xvii} Sensor for terrestrial and Airborne Radio-transmitter rescue search <https://cordis.europa.eu/project/id/033742>
- ^{xviii} Ultra Wideband Radio application for localisation of hidden people and detection of unauthorised objects <https://cordis.europa.eu/project/id/32744>
- ^{xix} The COntribution of Social Media In Crisis management <https://cordis.europa.eu/project/id/312737>
- ^{xx} ATHENA <https://cordis.europa.eu/project/id/313220>
- ^{xxi} Online and Mobile Communications for Crisis Response and Search and Rescue <https://cordis.europa.eu/project/id/312850>
- ^{xxii} Integrated Components for Assisted Rescue and Unmanned Search operations <https://cordis.europa.eu/project/id/285417>
- ^{xxiii} Mobile Robots with Novel Environmental Sensors for Inspection of Disaster Sites with Low Visibility <https://cordis.europa.eu/project/id/645101>
- ^{xxiv} Robust Mobility and Dexterous Manipulation in Disaster Response by Fullbody Telepresence in a Centaur-like Robot <https://cordis.europa.eu/project/id/644839>
- ^{xxv} RoBot for Autonomous unDerGround trenchless opERations, mapping and navigation <https://cordis.europa.eu/project/id/731968>
- ^{xxvi} Coordinated Use of miniaturized Robotic equipment and advanced Sensors for search and rescue OpeRations <https://cordis.europa.eu/project/id/832790>
- ^{xxvii} AeRial RObotic System for In-Depth Bridge Inspection by Contact <https://cordis.europa.eu/project/id/687384>
- ^{xxviii} Collaborative Aerial Robotic Workers <https://cordis.europa.eu/project/id/644128>
- ^{xxix} MOBILE NETwork for people's location in natural and man-made disasters <https://cordis.europa.eu/project/id/687338>
- ^{xxx} AeRial RObotic technologies for professiOnal seaRch aNd rescuE <https://cordis.europa.eu/project/id/780960>

xxxi Improving Resilience to Emergencies through Advanced Cyber Technologies
<https://cordis.europa.eu/project/id/700256>

xxxii BeAWARE Project <https://beaware-project.eu/>

xxxiii EnhANcing emergencY management and response to extreme WeaTHER and climate Events
<https://cordis.europa.eu/project/id/700099>

xxxiv Search And Rescue Aid and Surveillance using High EGNSS Accuracy
<https://cordis.europa.eu/project/id/776099>

xxxv Study on Innovation in Horizon 2020 Projects. A content analysis of 233 innovation project proposals awarded in 2015 EUROPEAN COMMISSION Directorate-General for Research and Innovation

xxxvi Grand Agreement Project S&R - Annex 1 – Description of Action (part B), pag. 19