Call topics

2014 SAF€RA joint call on

Innovating in safety and safe innovations

May 2014

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SAF€RA's 2014 joint call on *Innovating in safety and safe innovations* addresses two topics:

- T1: Managing emerging risks
- T2: New technologies for safety

The subtopics identified for these two topics are described below. Please note that the research questions listed for each subtopic are not intended to be exhaustive. Research proposals may address other related research questions, if they are included within the scope of the topic and subtopic. The funding available for each topic is not related to the length of its description in this document.

The questions addressed by this call are relatively broad, and will often benefit from inputs from several scientific disciplines. Multidisciplinary or inter-disciplinary proposals are encouraged. It is anticipated that the following disciplines can provide useful contributions to the call: engineering and the natural sciences, management science, economics, law, organization studies, political science, psychology. Proposals including other disciplines are welcomed.

Research proposals which adopt a **comparative approach** (analyzing similarities and differences between different European countries, between different industry sectors, between large and small organizations, *etc.*) are encouraged.

Scope of the call

The scope of the call includes research on the management of industrial risk, avoiding major impacts on the environment or society. The scope also includes research on products and systems required to improve safety in industrial settings.

Industries involved include, among others, the process industries, energy, dangerous goods transport, construction and operation of major infrastructure and the services industry.

The scope includes occupational safety as long as there is a relation with major accident hazards in industrial settings. For example, if research primarily with an occupational safety perspective aims to prevent an accidental sequence which could also lead to off-site consequences, then it is included in the scope.

T1: Managing emerging risks

Context. Emerging risks[1] arise from innovation (new technologies, processes and organizations), from new applications of existing technologies and from unanticipated contexts or events. Traditional risk management approaches, based on static assessments leading to risk controls which are established before launching an activity, are not suited to highly dynamic and evolving environments. This call aims to support investigations into new techniques for assessing and controlling emerging risks.

[1] The ISO 31000 standard gives an approach to and a definition of "risk" in this context.

The following list of emerging risks in industrial situations aims to illustrate the sectors which may be addressed by potential projects, without aiming to be exhaustive:

- increased use of energy carriers such as LNG, leading to a greater degree of exposure of society to explosion hazards
- incorporation of hydrogen production from renewable energy sources in natural gas distribution systems, leading to questions on the performance of sealings and of pumping systems
- carbon capture and sequestration
- transport of novel hazardous materials
- production and use of new biofuels, with greater degrees of chemical aggressiveness
- new forms of work organization, such as the increasing use of virtualization technologies and other organizational changes with increased psycho-social impacts
- increasing presence of non-native workers on certain industrial sites, leading in some cases to communication problems and cultural misunderstandings.

Please note that research related to risks of nanotechnologies, which are covered by a number of other specific calls and ERA-NETs, are not within the scope of the present call.

This topic includes questions organized under the following headings:

- Validity and limitations of techniques for assessing emerging risks
- Improving decision-making concerning emerging risks
- Framework and regulation mechanisms for emerging risks

Validity and limitations of techniques for assessing emerging risks

- Are scenario-building or other "futurology" approaches useful as tools for the early identification of emerging risks?
- What are the limitations of existing risk assessment techniques and risk indicators with respect to emerging risks? For instance, how to find an appropriate balance between ensuring that risk assessment is taken into account early in the technology-development phase, and avoiding investment on hazards that might never appear?
- Can new risk assessment methods and new risk indicators (including leading indicators, based on scientific analysis of possible threats despite the absence of available data) help to cope with these limitations?

Improving decision-making concerning emerging risks

- How can uncertainty be incorporated in risk assessment? This includes questions related to estimation of the uncertainty in the outputs of consequence models, to uncertainty representation and propagation in models, and to uncertainty communication.
- How can the uncertainty associated with risk assessment results be presented to decision-makers in a correct way to help them to reach informed decisions? In particular, when the outputs from different families of models (insurance, engineering, finance) are used as inputs to decision-making, how can different types and representations of uncertainty be presented in a coherent manner?
- How can decision-makers incorporate uncertainty in their sense-making and decision-making process and **justify their decisions**?

- What are relevant **acceptability criteria** for emerging risks? How can the evidence-based imperative be made compatible with the desire to prepare for “black swans”? What do concepts such as risk, acceptability and the precautionary principle mean in the context of emerging risks? How can stakeholders be involved in the decision process?
- How to communicate and to consult on emerging risks?
- Can **continuous improvement** approaches to decision-making[2] allow new information to be taken into account?

What framework[3] and which regulation mechanisms are most appropriate for emerging risks?

- What are the validity domain and the limitations of existing frameworks when managing emerging risks?
- What type of **regulation regime** (for instance, balance between “control-and-command” and “goal-oriented”) is best suited to these contexts with high uncertainty? What methods should be used for examining operating permits and safety cases (moving beyond classical approval processes, which are relatively static in nature)?
- How should **responsibility** and **accountability** be allocated in the presence of hindsight bias[4], without hindering innovation?
- What types of activities, governance mechanisms (such as self-regulation in certain sectors) and communication lead to **confidence for stakeholders** when dealing with emerging risks?

Research types. The following types of research are expected for topic 1:

- **case studies** which can identify approaches used to manage (including issues related to communication) a specific risk, and identify strong points and weaknesses**;**
- **empirical evaluation** of current practices (econometric approaches, surveys, *etc.*, including mixed methods);
- development and evaluation of **practical methodologies/tools;**
- exploratory studies (appreciative inquiries).

Given the nature of research questions concerning safety, multi-disciplinary projects are particularly encouraged.

[2] Seeing decision-making as an adaptive, dynamic process rather than a one-shot process, and aiming for *better* decisions rather than *the best* decision.

[3] The ISO 31000 standard gives an overview of the meaning of the term “framework” in this context.

[4] Hindsight bias: it is easy to feel, after an event has occurred, that the event should have been easy to predict by people at the time.

T2: New technologies for safety

This topic comprises three subtopics:

- T2.1: Smart and safe working environments
- T2.2: Smart and safe transport of hazardous materials and goods
- T2.3: Experimental and theoretical investigation of decomposition of hazardous substances

T2.1: Smart and safe working environments

Context. A number of new technologies (sensors, actuators, displays and computational elements generally connected by a network) are being introduced in the workplace in order to improve both productivity and workers' wellbeing and autonomy, enhancing the synergy of the interaction between humans, technology and the organization. The aim of the call is to allow **concept development** and **pilot tests** of **novel uses of existing technologies for safety management in smart working environments**. The call does not aim to support the development of new technologies[5] (and indeed, the budget available is too low for such purposes), but rather to support experimentation with new uses of existing technologies which have been developed for applications in areas such as medicine, security, military, and aeronautics.

The following list of **sample applications** aims to illustrate the nature of potential projects, but should not be read as specific objectives of the call:

- An acoustic-based early-warning system detects fatigue-induced cracks in a refinery, and workers in the unit are informed in real-time of the reason for an emergency shutdown (technologies involved: non-destructive testing for continuous monitoring of equipment in service, defect/failure testing, augmented reality).
- Emergency responders intervening in an accident can obtain information on the hazardous goods present (technologies involved: RFID tagging, communications networks, augmented reality).
- A worker in a railway yard can consult a mobile terminal that combines knowledge of the risk inventory in his surrounding area and upcoming railway movements, and is able to warn him in real-time of possible hazards in his surroundings (technologies involved: smart sensors, wearable computing, internet-of-things, big data).
- A welder is equipped with a smart helmet that monitors the quality of the weld in real time, and warns him of possible safety issues (technologies: smart sensors, wearable computing, welding).
- Personalized warning systems for emergency alerts: workers with hearing deficiencies or lower sight can have different thresholds for warnings, and appropriate information modalities such as touch communication can be used.
- Early-warning of hazards, such as abnormally high temperatures, presence of toxic or flammable gases, lack of oxygen in confined spaces, potentially occurring in industrial settings (technologies: smart sensors, wearable computing).

Proposals targeting synergy of the interaction between humans, technology and the organization would be of most interest. Particular attention will be paid to projects that aim to integrate several new technologies to enable **dynamic (personalized, real-time) risk management**. Whereas

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[5] Technology development of these smart working environments is encouraged by initiatives such as the Factories of the Future 2020 PPP, and the Manufuture technology platform.

traditional approaches to managing risk exposure are static and zone-based, smart technologies allow multiple data sources to be collected and integrated to assess risk in real time, possibly on a personalized basis (anticipating the link between a hazard and a vulnerable element). Such applications offer potential for more effective safety alerts and more flexible working environments.

Researchers are encouraged to consider a number of secondary questions in their responses to the call:

- What are the **psychological and social impacts of innovations** within companies? For instance, what are the **privacy implications** of increased deployment of smart technologies for workers?
- When technologies improve workers' situational awareness, what **redistribution of decision-making** (for instance in triggering an emergency shutdown) can be envisaged between the sensor network, the worker and the unit manager? What are the implications in terms of responsibility, and those for policy and regulations?
- What is the impact of these technologies on maintenance strategies (possibly, reducing the need for long maintenance shutdowns).
- Is there a possibility of producing security alerts (theft, perimeter protection…) as a by-product of the deployment of smart technologies?

Research types: Projects should aim for concept development and pilot tests rather than technology development.

T2.2: Smart and safe transport of hazardous materials and goods

Context. Risk assessment techniques and regulations concerning the transport of hazardous materials vary considerably between EU Member States. This lack of harmonization leads to fragmented approaches to risk management and increased costs in the chemical supply chain. New technologies (geolocation, real-time decision-support systems based on big data, next generation storage materials based on functional materials) and new approaches such as multimodality offer the possibility of improving the safety, sustainability and efficiency of hazmat transport within Europe.

The following list of **sample applications** aims to illustrate the nature of potential projects, but should not be read as specific objectives of the call:

- A smart container system, based on real-time communication of the location and future route of hazardous goods, makes it possible to prevent the cohabitation of incompatible hazardous substances (on railway lines and freight classification yards, on nearby highways, on airplanes and ships).
- A real-time decision-support system allows a logistics service provider to optimize its use of complementary transport routes (railway, road, pipeline, barge, ship and air), depending on forecasts of weather, transport congestion and customer demand.
- A new generation of dangerous goods containers (or fixed storage facilities) built using fibre-reinforced functional materials include fiber-optic sensors that can detect strains on the container before they lead to failure. The sensors are able to distinguish between normal aging effects and approaching loss of containment. They communicate with an early-warning safety management system to enable prompt replacement of the container.

Research questions: Particular attention will be paid to projects that aim to integrate several new technologies to enable **dynamic, real-time risk management** for the transport and storage of hazardous materials and goods.

Research types: Projects should aim for concept development and pilot tests rather than technology development.

T2.3: Experimental and theoretical investigation of decomposition of hazardous substances

Context. The use and application of hazardous (energetic, reactive) substances requires extensive knowledge about their properties and behaviour. A variety of large-scale and lab-scale methods exist, requiring dedicated facilities. They also require the use of large quantities of materials which are often not available during development phase and/or which are very expensive. Moreover, use of large amounts can have a detrimental effect on the environment. Use of small-scale methods and simulations to predict the properties and behaviour of such materials will help to overcome these problems. Furthermore, small-scale methods can help to predict the behaviour of hazardous materials at large scale. QSPR[6] methods are a useful complement to small-scale testing and simulation techniques.

Examples of such materials and their applications include:

- Hydrogen peroxide and inorganic persalts used in propellants
- Organic peroxides used as initiators in the polymer industry
- Ammonium nitrate used in fertilizers
- Use of energetic organic compounds (*e.g.* nitro compounds) in pharmaceuticals
- Storage of large amounts of potentially self-heating materials (coal, ore, sludge)
- Use of energetic monomers, capable of undergoing a runaway reaction

Research types: Concept development and pilot tests of new characterization methods, either experimental or simulation-based.

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[6] In chemical engineering and toxicology, Quantitative structure–property relationships (QSPR) analysis involves modeling a chemical property (such as the activity of a molecule) as the response variable of a mathematical model.