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Abstract:

This document provides the first strategic research and standardisation agenda to improve fire and rescue capabilities in Europe. It is built on the cycle#1 of Fire-In project outputs.
In a first part, the document delivers the rationales for selecting a set of strategic challenges to be addressed: relevant priorities from the practitioner viewpoint, gap analysis in regard the current existing solutions screened, and feedback from the interaction with research, standardization and technology networks and actors.
In a second part, the document proposes action sheets to open the selected challenges to research and innovation calls.

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Executive Summary

The FIRE-IN project is an initiative funded by the European Commission and initiated on the 1st of May 2017. FIRE-IN has been designed to raise the security level of EU citizens by improving the national and European Fire & Rescue (F&R) capability development process. FIRE-IN addresses the concern that capability-driven research and innovation in this area needs much stronger guidance from practitioners and better exploitation of the technology potentially available for the discipline.

The purpose of this report is to synthetize and merge the results from the first cycle of FIRE-IN process, i.e.:

a. The definition of capability challenges expressed by practitioners;
b. The screening of existing resources to address the challenges;
c. The feedback from research and technology providers regarding ability to bridge the gaps.

As a result, the reports guides the European Commission on a first strategic research and standardization agenda that focuses on a top two key challenges to invest on:

- Foster risk tolerance and resilience.
- Boost interaction with the public during crises.

Table 1. FIRE-IN partners

Participant No.	Participant organisation name	Part. short name	Country
1	Pôle de compétitivité SAFE CLUSTER (ex Pôle Pégase)	SAFE	France
2	Ecole Nationale Supérieure des Officiers de Sapeurs-Pompiers – French National Fire Fighter Officers Academy	ENSOSP	France
3	Italian Ministry of Interior, Department of Fire Corps	CNVVF	Italy
4	Bundesanstalt Technisches Hilfswerk	THW	Germany
5	Global Fire Monitoring Center	GFMC	Germany
6	INERIS Development	INEDEV	France
7	Fraunhofer INT	FhG-INT	Germany
8	Fire Ecology and Management Foundation Pau Costa Alcubierre	PCF	Spain
9	Catalonia Fire Service Rescue Agency	CFS	Spain
10	Scientific and Research Centre for Fire Protection	CNBOP	Poland
11	The Main School of Fire Services	SGSP	Poland
12	Council of Baltic Sea States Secretariat	CBSS	Sweden
14	Center for Security Studies	KEMEA	Greece
15	Czech Association of Fire Officers	CAFO	Czech Republic
16	inno TSD	inno	France

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1. Introduction

One of the main objectives of FIRE-IN project is to provide recommendations to develop research and standardization that is aligned with both practitioners' needs and research and technology developers (RTD)' capabilities. Therefore it can only happen after a full cycle of the project is completed: i) identification of challenges from the practitioners' perspective; ii) screening of existing solutions; iii) consultation with industry and research networks.

The final objective is to provide inputs for the European Commission to build the roadmap of research and standardization in the field of fire and rescue. As the FIRE-IN project is made of three cycles, this deliverable delivers the first cycle's results.

In the first part, we detailed the process used to select operational priorities. We firstly identified top six challenges from practitioners' workshops outputs; then we assessed windows for innovation from the screening of the RDI and the gap analysis done in WP2; finally we interacted with RTD actors and networks to get feedback on potentialities and industrialization capabilities. At the end of this first part, we did a special focus on standardization matters, as the concept itself covers different items, which require to be detailed.

In the second part, we structured recommendations into action sheets to frame research and innovation regarding the two key topics identified: 'Foster risk tolerance and resilience' and 'Boost interaction with public during crises'.

2. Defining strategic axis

2.1. Top six challenges for practitioners

During the first cycle of workshops (February-March 2018), expert practitioners participated in five thematic workshops:

a. Search and Rescue (SAR) and Emergency Medical Response (EMR).
b. Structure fires crisis mitigation, prevention and protection.
c. Vegetation fires crisis mitigation.
d. Natural Disasters crisis mitigation.
e. CBRNE crisis mitigation.

Cumulatively, 141 people from 17 countries were implied in the exchanges[1].
These workshops followed a structured method so that the experts identified the capability gaps from crisis scenarios established by the workshops facilitators.

When considering the results of the workshops, commonalities appeared; they are called Common Capability Challenges (CCCs)[2].

[1] Sébastien Lahaye, 'Fire-In D4.2 Annual Report on Interaction with Practitioners and Existing Networks and Dissemination Conference #1' (Fire-In consortium, 30 April 2018).
[2] Sébastien Lahaye et al., 'Fire-In D1.2 Report on Current and Future Common Capability Challenges (CCCs and FCCCs) #1' (Fire-In consortium, September 2018).

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It appeared that these CCCs could be organized in four generic challenges and seven main capabilities.

2.1.1. Four generic challenges

The challenges identified in the workshops were all related to one of the following themes:

High flow of effort in hostile environment

- ✓ A fast arrival and the capacity of sustaining efforts in time are key.
- ✓ There is a need to work inside a hostile environment, and to organize efforts from outside.
- ✓ A bottleneck is to maintain operative effort in time.

Low frequency, high impact events:

- ✓ These events are emergencies that exceed firefighter's capacities and have a high impact on the society.
- ✓ Low Frequency means very few opportunities to acquire and maintain the needed expertise. Fragmentation of fire services reduces expertise.
- ✓ A bottleneck is to develop capabilities in fire services and in the society.

Multi-agency/multi-leadership environment:

- ✓ There are often multiple decision-makers (=leaderships) at different levels and from various agencies, with overlapped competences. Sometimes there are also unknown and unclear stakeholders.
- ✓ There are complex integration of interests, decision-making levels, communication system, cultures, languages...
- ✓ A bottleneck is to integrate the decision-making in short time at different scales and levels focusing on strategic objectives.

High level of uncertainty

- ✓ Dynamic, unexpected risks and opportunities are emerging in a large area.
- ✓ High flow of new incidents that overcome the available resources; changes in situations exceed the communication capacities.

2.1.2. Seven main capabilities

The challenges also refer to one (or several) of the seven following capabilities:

- Pre-planning
- Guidance instruments
- Incident Command Organization
- Knowledge cycle in the fire service
- Information management
- Community involvement
- Technology

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The resulting matrix is shown in Table 1.

Table 1. Matrix of Common Capability Challenges

	High flow of effort in hostile environment	Low frequency, high impact	Multi-agency / multi-leadership environment	High level of uncertainty
Incident Command Organization	Focus on sustainability of safe operations	Prioritize the reduction of vulnerability and increase interactions with the public	Distribute decision-making	Strategies choosing safe scenarios, and maintaining credibility
Pre-planning	Pre-plan a time-efficient, safe response	Negotiate solutions with stakeholders for anticipated scenarios	Plan interoperability and enhance synergies	Focus on governance and capacity building towards more resilient societies
Guidance instruments	Establish procedures and guides	Standardize capabilities in front of pre-established scenarios.	Establish an interagency framework	Build doctrine for resilience in emergency services and societies
Knowledge cycle	Train specific roles	Learn about possible scenarios focusing efforts in key risks and opportunities	Build a shared understanding of emergency and train interagency scenarios	Focus on integral risk management
Information management	Information cycle.	Manage key information focused on decision-making	Define common information management processes between agencies.	Provide an efficient, flexible flow of information for a shared understanding
Community involvement	Develop public self-protection to minimize responders exposures	Prepare population for the worst scenario before it happens.		Cultural changes in risk tolerance and resilience
Technology	Use technology to assess risks and minimize responder's engagement	Simulate complex scenarios	Technological tools to support data sharing	Get a clear picture of the risk evolution

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Within this matrix, made of 27 CCCs (the community involvement in multi-agency environment did not make sense as a CCC), the Fire-In consortium decided to identify the six most important challenges, from a practitioner's viewpoint. This prioritization appeared as a necessary step to process efficiently the next stages of the project.
Therefore, during a consortium meeting in Barcelona in May 2019, the partners involved in the management of the workshops, also very representative of practitioners in Europe, choose these top six challenges:

1. Focus on governance and capacity building towards more resilient societies
2. Cultural changes in risk tolerance and resilience
3. Use technology to assess risks and minimize responders' engagement
4. Prioritize the reduction of vulnerability and increase interactions with the public
5. Negotiate solutions with stakeholders for anticipated scenarios
6. Plan interoperability and enhance synergies

2.2. Gap analysis from screening

In Work Package 2, an extensive screening of existing solutions and resources, i.e. projects, publications and standards, was conducted for each the 27 CCCs that were identified during the first cycle of workshops. The results, even after checking the relevance of each input, provided hundreds of resources[3].
However, to better address the real availability of solutions and resources for practitioners in regard each the identified CCC, a traffic light system was built.
The process encompassed different parameters, as described in Table 2.

Table 2. Generic criteria for the traffic light system

Criteria	Green	Yellow	Red
Operational value	Many projects on the topic, that are already completed and delivered available knowledge in articles and guidance documents	Few projets completed on the topic, sometimes only at national level. 1 or 2 on-going projects.	Further research and development needed.
Access to knowledge	Peer reviewed international guidance document or standard available Training courses available.	A few papers available sometimes only at national level	Only papers or communication pointing the need to address the topic

As a result, the CCCs matrix turned coloured as follows (Table 3):

[3] Claudia Berchtold et al., 'Fire-In D2.2 RDI and Standardisation Screening Report' (Fire-In consortium, January 2019).

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Table 3. Traffic light process applied on the matrix of CCCs

	High flow of effort in hostile environment	Low frequency, high impact	Multi-agency / multi-leadership environment	High level of uncertainty
Incident Command Organization	Large variety of projects and articles on technological and non-technological solutions	Some projects and articles on mainly social media and ICT tools	Many projects and articles on crisis management, coordination, networks and collaboration	Very limited information available
Pre-planning	Some projects and articles on expertise sharing, exercises, decision support and data/information	Few projects and articles, mostly on 9/11.	Many projects and articles on information sharing, decision support, exercises	Many projects and articles on resilience and collaboration
Guidance instruments	This topic is addressed specifically in section 2.4 of the deliverable			
Knowledge cycle	Some projects and articles on training personnel, including e-learning and serious gaming	Some projects and articles on a variety of large scale incidents like large fires, nuclear emergencies	Many projects and articles on interoperability and information systems	Many projects and articles on risk interdependencies, monitoring and preparedness
Information management	Many projects and articles on technological and non-technological solutions on how to improve emergency response	Few projects and articles on how to respond to extreme events	Many projects and articles on information sharing between agencies, systems, and citizens; on information networks; on geospatial information systems	Very few articles
Community involvement	A lot of articles but few projects on the following “community” related topics: Resilience, communication, collaboration.			
Technology	39 solutions with a TRL ≥ 9 already found on the market	Only 13 solutions with a TRL ≥ 9 and with unclear interoperability	44 solutions with a TRL ≥ 9 already found on the market	Only 10 solutions with a TRL ≥ 9

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On the one hand, for challenges coloured in green, there are already many resources or solutions on the market. On the other hand, challenges coloured in red are the ones that just emerged and that have been very poorly investigated by research and innovation actors.
Any future strategic research agenda should therefore focus on those CCC fields that are yellow or red. While yellow CCC fields may simply require additional funding to push development, red fields will require a more substantial effort, for example including an assessment of why this area of research has thus far been severely neglected. The information from this analysis of CCCs can be used to show how the top six challenges that were identified by the practitioners previously are covered:

1. Focus on governance and capacity building towards more resilient societies
2. Cultural changes in risk tolerance and resilience
3. Use technology to assess risks and minimize responders' engagement
4. Prioritize the reduction of vulnerability and increase interactions with the public
5. Negotiate solutions with stakeholders for anticipated scenarios
6. Plan interoperability and enhance synergies

So the first cycle of FIRE-IN process definitely guides the strategic research agenda towards three key challenges, including the two in yellow that are both dealing with interactions between Fire and Rescue Organizations (and policy makers) and the communities: one to increase resilience thanks to better engagement in the preparedness phase; the other to better interact during the crisis phase. These are the two challenges we decided to focus on for the first cycle of strategic agenda.
Fire-In will concentrate more efforts to address the red challenge, very slightly investigated for now in Europe, in further developments of the project, i.e. in next cycles.

Noticeably, three of the top six challenges identified by practitioners are already covered by a wide spectrum of resources, research or solutions. That reveals how poor is the dissemination of RTD efforts in the Fire and Rescue practitioners' community.
This important reality has been integrated by the FIRE-IN consortium so that the process of next cycles is now modified.
However, it is also an important input that the EC should consider for the strategic research agenda: projects to come in the arena of fire and rescue, whatever the topic, should absolutely include a large part on dissemination towards end-users. This part should include touching activities such as demonstrators.

2.3. Feedback from RTD

Because the first stages of the project initially lead to a very large and detailed set of CCCs and because the screening also revealed a huge quantity of existing resources and solutions, it was difficult to engage with research and technology developers and networks to collect their initiatives and capabilities to fill the remaining gaps.
In alignment with this deliverable, the two key challenges detailed in the action sheets in part 3 below will now be distributed to the RTD networks to get more feedback.

However, the interactions generated during the dissemination event between RTD providers and practitioners also reveal potentialities in the further stages of the project implementation, especially for face-to face meetings as the ones associated to these types of events.

One major issue in securing more ideas from RTD organisations is that they are afraid of data leaks and industrial espionage. RTD organisations simply were uncomfortable to share what topics they are

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working on. Future communication needs to highlight how their participants can actually help them in steering their research to address end-user needs and develop tools that are accepted by end-users.

2.4. Standardization matters

During the consultation process, practitioners have expressed a lot of demands related to standardization with expectations to improve the harmonisation of the practices to facilitate international cooperation, to enable the interoperability and compatibility of the equipment and to make the public procurement procedures more efficient.

2.4.1. Use of the term "standard"

The discussion during the 2nd annual symposium in Rome in 2018, as well as several discussions to deepen the topic of standardization have led to distinguish two type of standards:

- The formal standards developed in the international standardization committees such as CEN or ISO;
- The standards that become a reference document in a profession, because it reflects the state of the art in a domain and represent a certain consensus.

During the Bridgit2 project[4] meeting in Brussels on November 9th, 2018, Dr. Annette Altenpohl (Austrian standard Organisation) proposed the general definition of a standard: it is "an agreement on how it should be". And in fact, this is also the intuitive understanding and meaning of the term "standard" for the practitioner point of view. FIRE-IN distinguishes two types of standards: "professional standards" and "formal standards".

Professional standards correspond to documents developed for practitioners by institutes, professional associations or international governmental organizations that become a reference document reflecting good practices.

Formal standards correspond to documents developed in the framework of international standardization committees such as CEN, ISO… or national standardization associations such as NFPA.

It is important to note that most of the practitioners are not familiar with formal standards and they generally do not access them because they are not freely available but need to be bought
By contrast, professional standards are usually openly accessible for download on the websites of the associations or institutions. Their dissemination is quick and without barriers.

2.4.2. Professional standards

Guidance documents describing good practices can be found on the Websites of international associations and also national associations.
e.g. https://www.ctif.org/index.php/resources, https://www.f-e-u.org/working-docs.php

[4] https://www.cencenelec.eu/research/BRIDGIT2/Pages/default.aspx

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These are the professional standards that were the most demanded by practitioners during the consultation process.

To be largely implemented the professional standards should be accessible in the language of the user.

2.4.3. Formal standards

Formal standards are of course necessary even if they are not the expressed priorities of the practitioners. They are needed especially in the ICT domain to assure that the innovative technologies and equipment can be compatible and interoperable.
These features are beneficial for the practitioners and the users, but the supplier industry has to pay attention to this requirement and take care of the standardization process.

2.4.3.1. Standards for interoperability

In reference to the work carried out in the ResiStand[5] project, the main goal of standardisation in the field of fire & rescue and disaster management is to improve interoperability between organisations. This because the overall assumption is that the collaboration of practitioners of disaster management and resilience operations nationally and internationally will be easier due to increasing technical, procedural, operational and semantic interoperability between relevant organisations, systems and tools. This will lead to faster response, less overhead work and finally, to significant financial savings.

2.4.3.2. Standards to support efficient public procurement procedure

In order to improve public procurements on the fire & rescue market, it is necessary to improve the procedures and to allow public procurers to refer to relevant standards.
It is therefore recommended to develop a set of standards describing how to prepare an effective tendering in the frame of a public procurement for technologies and equipment.
In relation to the expression of the needs of practitioners, it is proposed to develop a standard or a best practice document describing the procedure for the implementation of public procurement in this sector, with reference to expected performance and quality of the products or services to be purchased.

Fire and rescue might also constitute a market for public procurement that should support the uptake of innovation. The following instruments could be implemented:

- Direct Public Procurement,
- Pre-Commercial Procurement,
- Public Procurement of Innovation.

These approaches are described in brief hereunder.

- **Direct Public Procurement** has been a significant policy and regulatory consideration for the European Commission (EC) for over a decade. Public procurement accounts for 20% of EU GDP, and efficient public procurement in the Single Market can significantly reduce costs. The EU target of 100% e-procurement by 2016 aims for “End-to-end [public] e-procurement to modernise public administration”. Conforming to EU

[5] http://resistand.eu/

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Procurement regulations is easier for simpler procurements, but challenging for complex scenarios, and so guidance is required.

- **Public Procurement of Innovation (PPI)**[6] is a strategy often used in conjunction with PCP, and allows a group of public authorities to jointly foster innovation in a way that ensures it can spread to other adopters more widely. Public authorities act as a launch customer for innovative goods or services. These are typically not yet available on a large-scale commercial basis and may include conformance testing. Creating initial demand that then demonstrates public value in the innovation can stimulate wider interest by demonstrating cost savings, system functionality meeting user needs, and opportunities for joining an open approach with clear public benefit.
- **Pre-Commercial Procurement (PCP)**[7] is an approach within the public procurement of innovation, developed specifically for the procurement of R&D services rather than actual goods and services; if the goods or services developed during the R&D phase are to be procured, this would need to be based on a separate procurement process. PCP is used to ensure development of solutions to meet public sector needs. PCP strategies can be used to support groups of public procurers to work together on shared innovations, and to allow public authorities to directly steer developments of required solutions. Working together on joint initiatives means procurers and suppliers share risks at different stages of the development and implementation process. This strategy is under-exploited, mainly because of a given lack of understanding. Therefore, it is important to develop guidelines on how PCP can be implemented in practice.

Knowing these procedures can bring direct benefits to the practitioners who might be able to use the material and equipment they wanted according to the performance criteria and not the material and equipment the public procurers are forced to purchase if the main criteria is the price.

2.4.4. Way forward

In the CCC matrix, the need for standards has been summarized as follows:

High flow of effort in hostile environment	Low frequency, high impact	Multiagency / multileadership environment	High level of uncertainty
Establish specific procedures and guides facilitating operability	Standardize capabilities in front of pre-established scenarios	Establish an interagency framework	Build doctrine for resilience in emergency services and societies

More details are available at: http://fire-in.eu/index.php/matrix-ccc/

[6] EU Procurement of Innovative Solutions https://ec.europa.eu/digital-single-market/en/public-procurement-innovative-solutions

[7] EU Position on Pre-Commercial Procurement https://ec.europa.eu/digital-single-market/en/pre-commercial-procurement

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Clearly the expression of the needs of the practitioners addressed the development of professional standards that aim at reinforcing the sharing of good practices and improving the cooperation.

From other European projects, in particular the Roadmap developed by ResiStand project, and the EDEN & DRIVER projects, the focus for formal standardization should be on the interoperability and the public procurement procedures.

While defining the full text of the 2 main challenges selected in the first FIRE-IN cycle, it is necessary to include considerations and expected impacts in terms of professional standards and when relevant specific formal standards focus on interoperability.

3. Action sheets

3.1. Foster risk tolerance and resilience

3.1.1. Description of the capability challenge

The capability challenge that gives rise to this action sheet is *Cultural changes in risk tolerance and resilience*. This challenge has been described by the practitioners with the following items:

- Use all opportunities for cultural changes in risk awareness and policies.
- Empower communities and stakeholders. Recognize and partner with existing civil-society initiatives addressing critical issues.
- Clearly disseminate that responders cannot protect everybody in case of major incident.
- Involve communities and stakeholders in pre-planning scenarios, in safety preparing and verification, and in drills and exercises.
- Change of paradigm. From 'We, authorities, will protect you' To 'You, citizen, should be actively involved'.
- Communication campaigns targeted to specific communities, with messages, exchanges and media carefully studied. Generate multi-language apps, with standardized symbols.
- Plan and prepare the involvement of volunteers and other civil society in the emergency.
- Educate kids and young ones.

The keywords extracted from the discussions between practitioners' experts are:
#understandsocioeconomicchallenges #awarenessofhistory #EuropeanPolicyFramework #TrainJournalists #trainlocalstakeholders #educatekids #voluntaryinvolvement

3.1.2. Role of policy makers and opportunities

The European states and their local authorities have massively invested in the last decades to increase the level of protection of their citizens. The European Commission has also recently contributed to the effort in funding the RescEU mechanism[8].

[8] European Commision: Strengthening EU Disaster Management: rescEU Solidarity with Responsibility, 2017 https://ec.europa.eu/echo/sites/echo-site/files/eu_disaster_management_rescue.pdf

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The largest part of all these efforts have been invested on strengthening the response capabilities, organising the fire and rescue organisations and giving them more resources.
However, in the context of recent major disasters, it has appeared that, whatever the strength of the response agencies, they may face crisis' complexities that are beyond their capabilities. In those situations, the agencies fail to protect population.
Noticeably, the FIRE-IN experts pointed out that possibility for all the thematic they were considering: mountainous rescue, high-rise building fires, tunnel fires, landscape fires, flooding and CBRNE attack.
Face to these extreme situations, the only way to build resilient societies is to prepare the population before a crisis happens and to involve them in the protection process.

Addressing this challenge requires to change the policy makers discourse from "we will protect you with our agencies" to "be prepared to face the worst situations as nobody else other than you will be able to help".
Interestingly, this is also the way that Australia has developed in the aftermath of the disastrous fires of February 2009 'Black Saturday'[9].

Research is required to analyse how authorities can shift this discourse. For example, it should assess if the context of post crisis situations provides good opportunities to initiate this shift. It should also analyse the role of expert and influential people in disseminating the idea: scientists, firefighters, volunteers, or local authorities. Research also needs to investigate socio-economic factors to define the best methods and tools, as detailed below.

3.1.3. Investigate socio-economic diversity

Engaging with the communities and involving them in their self-protection requires a good knowledge of the socio-economic dimension. There is no standardized method that would fit for all ages, rural and urbans, residents and tourists and so on.
Therefore, the social sciences are necessary in order to understand, on a given territory, e.g. what the population is made of, what is the level of understanding of the risk, or what are the adequate tools to reach everybody.

Beyond the traditional way to deliver top-to-bottom messages of awareness, the most efficient way to engage communities is to empower them in supporting local initiatives, i.e. the "bottom-up" approach. For example, building a local model of rural activities development on strategic area to reduce fire or flooding risk can be a win-win deal, boosting local economy and reducing the risk. Therefore, extensive knowledges of the territories' economics, strengths and opportunities are required to support such local projects.
Investigation to assess how the population could be engaged in mitigation measures and prevention planning is also required.

3.1.4. Investigate tools and strategies

Practitioners listed different tools to reach the communities, disseminate awareness messages and empower them as the key players in the resilience process:

[9] R. N. McLeod, S. M. Pascoe, and B. G. Teague, *2009 Victorian Bushfires Royal Commission : Final Report*, A Victoria. Parliament. Legislative Assembly. Votes and Proceedings of the Legislative Assembly ; Session 2006/10, No. 332 (Melbourne, Australia: 2009 Victorian Bushfires Royal Commission, 2010), http://www.royalcommission.vic.gov.au/Commission-Reports.

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- Use of social media.
- Awareness actions in schools.
- Promotion and densification of volunteer forces.
- Drills and exercises for the public, e.g. in high-rise buildings or tunnels.
- Thematic parks focusing on natural hazards prevention and protection.
- Public meetings involving experts.
- Collaborative approaches associating the citizens in prevention and planning measures.

While all these measures seem beneficial, the social sciences are strongly required to assess the potential impact, strengths and weaknesses of all these tools in the different contexts of Europe. The regional, and even micro-regional, diversity may indeed lead to use different strategies, depending on aspects such as the cultural background, the age or the local economy.

As a final result regarding this key challenge of fostering risk tolerance and resilience, the research agenda should focus on human and socio-economic studies and projects involving the development, the assessment and the reproducibility of local scale initiatives.
The best projects to support are the ones that do not start from scratch but are rather paved with existing initiatives and study the strengths, weaknesses and reproducibility of these initiatives.

3.1.5. Standardization aspects

Standardized procedures and tools to support the challenge "Cultural changes in risk tolerance and resilience" are needed to assure coherence of concepts and harmonised implementation within the European Union.

Some countries in the world are already working on the community engagement for crisis management, especially in developing countries where the governments do not have the resources to protect the people. For example, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA)[10], the United Nations Office for Disaster Risk Reduction (UNDRR)[11] and UN Environment Programme with APELL (Awareness and Preparedness for emergencies at local level)[12] have already developed some good practices in this domain.
In Europe, projects in FP5 and FP6, such as TRUSTNET 1 & 2 and TRUSTNET IN ACTION, have already studied the inclusive governance and the engagement of the communities in risk related issues, also in relation with crisis management with a case study addressing the SPPPI (French acronym about the prevention and preparedness local committees for technological risks).
At a national level, several countries have already developed and tested some approaches, e.g. in Sweden and France.

Based on this preliminary work, a professional standard should be developed at European level outlining good practices and examples of successful community engagement in developed countries.

[10] https://www.unocha.org/sites/unocha/files/OchaOnMessage_CommunityEngagement_Nov2015_0.pdf
[11] http://www.hkjcdpri.org.hk/download/policy/CommunityPreparednessPolicyBrief.pdf
[12] https://www.unenvironment.org/explore-topics/disasters-conflicts/what-we-do/preparedness-and-response/awareness-and-preparedness

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A European guidance document presenting the concept, the benefits and the practices for effective implementation should be developed.

In addition, to facilitate the harmonized implementation, it will be necessary to use existing formal standards developed by CEN TC391 Societal and citizen security:

- for the definitions and vocabulary: EN ISO 22300:2018 Security and resilience – Vocabulary), under revision.
- for vulnerability assessment: CEN/TS 16595:2013 CBRN - Vulnerability Assessment and Protection of People at Risk.

It might be relevant to establish further formal standards regarding the pictograms or ICT tools that will be developed to support the community engagement.

3.2. Boost interaction with the public during crises

3.2.1. Description of the capability challenge

The capability challenge that gives rise to this action sheet is '*Prioritize the reduction of vulnerability and increase interactions with the public*'.
This challenge has been described by the practitioners with the following items:

- Boost the public information function.
- Develop a specific communication strategy to maintain credibility, including social media.
- Shift of focus needed, from minimizing potential damages to reduce vulnerability for the final scenario, considering different values. Focus on key, relevant information. Anticipate relevant changes. Anticipate alternative scenarios, and contingency plans.
- Integrate feedback from community.

The keywords extracted from the discussions between practitioners' experts are:
#informationofficer #riskanalyst #decisionmaking #psychologicalcare #forensics #credibility #callcenters #predictivetools

3.2.2. Support the social expectation

The take-off of social media has revolutionized the flow of communication in the last decades. As a corollary, people expect to be informed on real time whatever the situation, especially when they are threatened by hazardous situations.
However, for many response agencies and authorities, the model is still to keep information and release only consolidated messages using traditional channels such as press releases or official communication. As a result, their credibility vanishes and citizens rush to alternative, uncontrolled communication channels.

Research is required to evaluate the impact of different communication strategies during crisis.
Because the resources of the states, the local authorities and the response services are heterogeneous, it is also necessary to investigate their capability to engage in this change of communication strategy and methods. The cultural aspects of both responders and population need to be considered.

Finally, research should demonstrate the benefit for organizations to keep connected permanently with population during crisis stages. In addition to the credibility they gain, they can also collect key information from the ground, feedback from victims and involved population.

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3.2.3. Define procedures

There are different strategies and several models of organization to engage efficiently with the communities on social media during crisis.
In the US Incident Command System, an information function, staffed as necessary, reports directly to the Incident Commander. The Australians, who are very pro-active on social media, organize the activity in the control centre. In Europe, different initiatives have emerged; one of them relies on a volunteers' network called VOST, for Virtual Operations Support Team www.vosteurope.eu.
Research, exchanges of knowledges and best practises are required to define the most appropriate model to develop.
To address the challenge, corresponding projects must associate both institutions and civil society representatives.

Beyond the simple exchange of information between fire & rescue agencies and citizens, engaging with communities during crisis also means that decision makers implement the real long term expectations of the community in their decision process.
Let's take an example, mentioned by FIRE-IN experts: in case a major event threatens hundreds of buildings and large areas, responders would basically concentrate their efforts to protect lives and properties. If the community argues that a certain agricultural area has more value than the buildings (because of resilience aspects), this statement has to be integrated into the decision process.
As this last point is being investigated by innovative fire agencies, the process may be supported by research and tools such as artificial intelligence based decision support tools.

3.2.4. Tools : standardization and interoperability

'Prioritize the reduction of vulnerability and increase interactions with the public' is one of the main issues of Crisis Management (CM) as proper information management is key for good CM. However, to reach the objectives, information released has be (at least) available, reliable, accurate, current, complete and relevant. For this reason, of high importance are the methods of obtaining information, their verification before the occurrence of an adverse event, during its duration and in the phase of removing its effects and restoring the normal state. The correct response to an adverse event is largely dependent on the availability and use of information about the event. In order to meet the needs of increasing security and raising the level of civil protection, new ways of ensuring security are sought through the creation of modern ICT tools and the use of existing ones.
The answer to such challenges may be, among others, the use of new technologies, including the use of modern communication tools, such as social media, as well as the creation of software supporting the preparation of crisis management plans.
The use of ICT tools to support the ES staff becomes important and almost mandatory especially during an emergency, which is an intensive period. Also, citizens expect emergency services to monitor their social media accounts and to respond to postings. The willingness of the public to participate and support ES in a crisis situation offers big potentials, providing that the right tools are deployed.
There are different tools that can support emergency services as well as apps for citizens for communication with ES.
There are also a lot of challenges involved in the implementation of these tools by the public and their common use. That's why this area needs to be still explored and adjusted for developing world.
One of the biggest challenges faced by solution providers and tool manufacturers is the issue of the correct use of information by the emergency services obtained via social media, and in particular the distinction of real information from false alarms and attempts to provoke panic.

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Another important issue is harmonization and interoperability between states and agencies. Currently, the 112 association is the only communication initiative that is harmonized across states.

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