Thematic reclassification and consistency analysis reports

Final Version of 05/01/2020

Deliverable Number D.3.2.1.

Project Acronym	E-CITIJENS
Project ID Number	10044361
Project Title	Civil Protection Emergency DSS based on CITIzen Journalism to ENhance Safety of Adriatic Basin
Priority Axis	2
Specific objective	2.2
Work Package Number	WP3
Work Package Title	MODELLING "SOCIAL MEDIA BASED" CIVIL PROTECTION EMERGENCY MANAGEMENT SYSTEM
Activity Number	3.2
Activity Title	Modelling a "social media based" Civil Protection Emergency system
Partner in Charge	PP5
Partners involved	All
Status	Final
Distribution	Public

Reclassification of risk scenarios and of their operational management, on the basis of common metrics and shared procedures, including cartographical representation

Report No.1

Summary

Introduction ... 3

1. Floods ... 6

1.1. Current flood risk scenarios ... 7

1.2. Flood sensory networks ... 10

1.3. Indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for flood risk ... 12

1.4. Flood risk communication to public ... 14

1.5. Inputs for enhancement of flood risk management ... 15

1.6. Points of interest ... 16

2. Forest fires ... 17

2.1. Current forest fires risk scenarios ... 18

2.2. Forest fire sensory networks ... 20

2.3. Indicators and parameters to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures for forest fire risk ... 22

2.4. Forest fire risk communication to public ... 23

2.5. Inputs for enhancement of forest fire risk management ... 24

3. Earthquakes ... 26

3.1. Current seismic risk scenarios ... 26

3.2. Seismic sensory networks ... 29

3.3. Indicators and parameters to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures for seismic risk ... 31

3.4. Seismic risk communication to public ... 32

3.5. Inputs for enhancement of seismic risk management ... 33

3.6. Points of interest....34
Conclusions....35
References....36
Data Sources....37
Floods....37
Forest fires....38
Seismic risk....38

Introduction

This report is part of the E-CITIJENS project, funded by Italy – Croatia Inter-Reg program. The main aim of the project is to increase the safety of the Italian and Croatian Adriatic basin in relation to natural and man-made disasters by developing a cross-border model of an emergency management system integrating risk scenarios data from sensor networks and regulatory frameworks and the information voluntarily provided via social media by the public (citizen journalism). Three risk areas are primarily considered: floods, forest fires, and seismic.

Work package 3 (WP3) consists of four main activities planned to achieve this goal; they are summarized in figure 1.

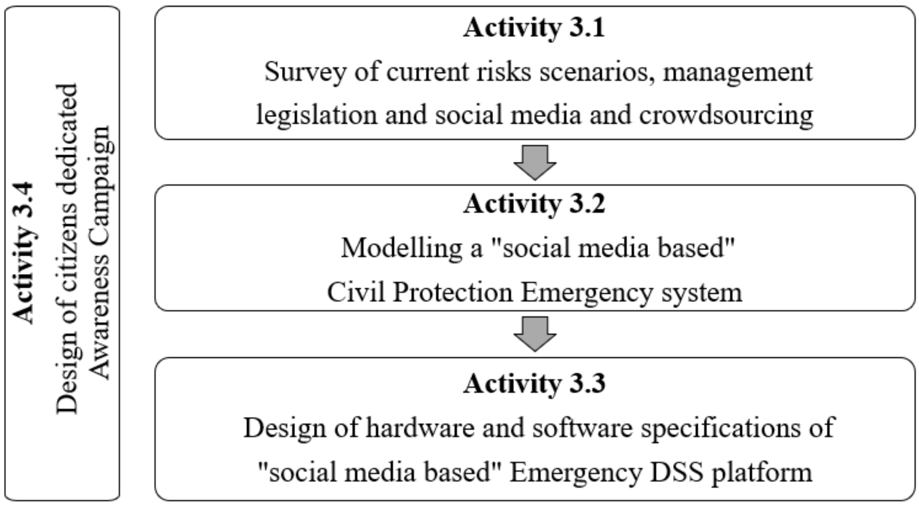


Fig.1: Overview of WP3 activities.

Activity 3.1, already concluded, consisted of the survey and assessment, besides best practices, of knowledge and experience from previous projects in Italy and Croatia concerning current risk scenarios, current civil protection management legislation and social media and crowdsourcing. A thematic task force (TTF) was set up for each of these three topics. In particular, TTF1 concerned risks scenarios, TTF2 risk management legislation and TTF3 social media and crowdsourcing (as shown in figure 2).

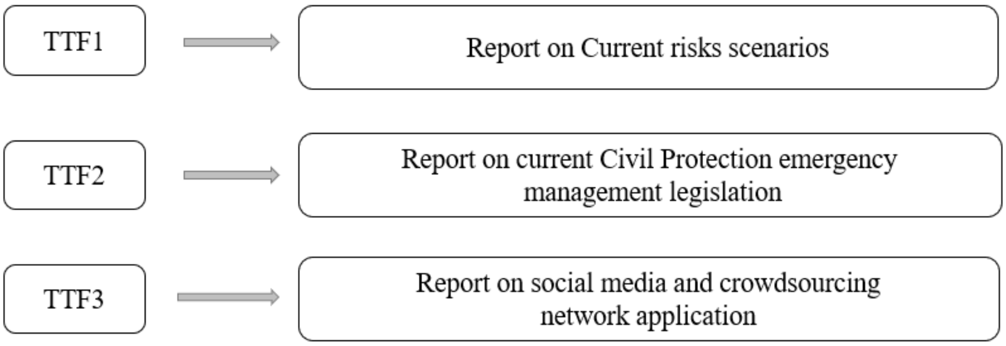


Fig.2: Activity 3.1 overview.

These three reports were elaborated on the basis of the information collected in three separate surveys that took place in July and August 2019, where all the recipients and the partners involved in each task force were asked to answer specific questions in relation to their knowledge and experience concerning the topics investigated. The information collected was discussed during the Project Meeting in Split (24th-25th October, 2019) in three working tables, that opened actually activity 3.2, in order to integrate it and to set the basis for possible future implementations.

The main aim of Activity 3.2 is a consistency analysis of the collected data in order to create a solid base for the modelling of a "social media based" Civil Protection Emergency system.

The main working areas of this activity are the following:

1) reclassification of risk scenarios and of their operational management on the basis of common metrics and shared procedures, including cartographical representation,
2) analysis of existing normative rules and procedures and their level of uniformity,
3) "social Media and crowdsourcing" hazardous events information flows, quality and location of information, semantic ontologies specific for each risk, and fakes identification criteria (common "language").

To better understand the relations between activity 3.1 and activity 3.2, an explanatory scheme is presented in figure 3.

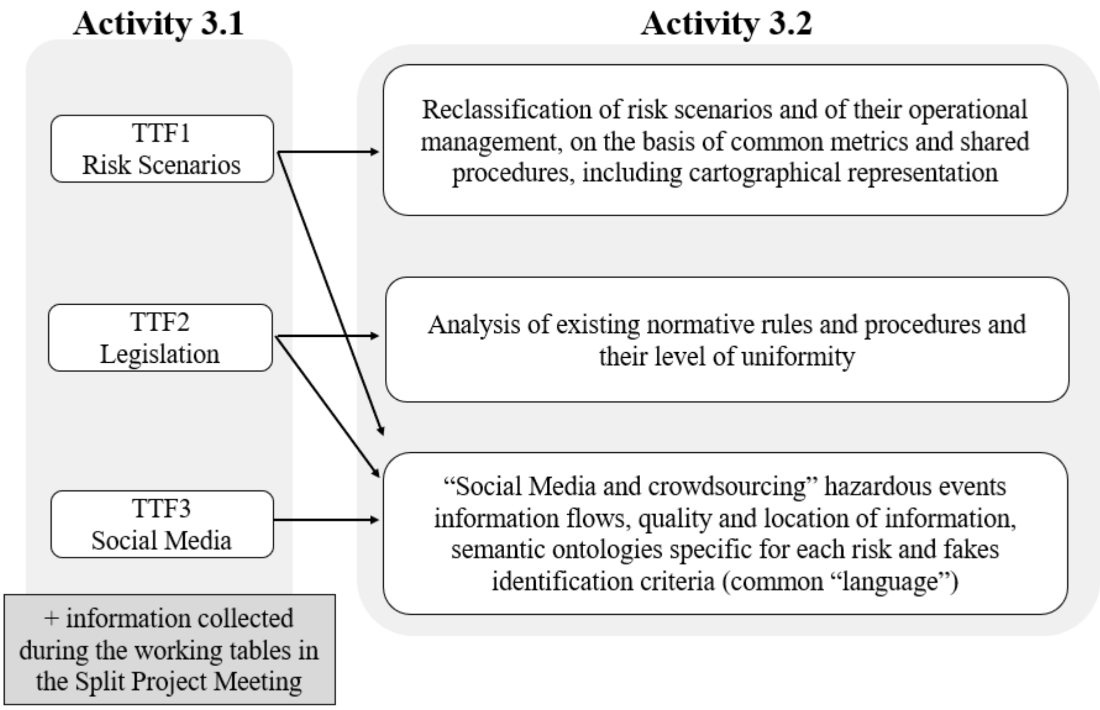


Fig.3: Relations between activities 3.1 and 3.2.

Is it clear that all three task forces of Activity 3.1 are fundamental for the third report of activity 3.2, which has been prepared by the University of Split, Faculty of Civil Engineering, Architecture and Geodesy.

The current report concerns working area 1 of activity 3.2 and aims, therefore, to present, integrated and reorganised, the information concerning risk scenarios and the operational management for the selected target risks of the project (floods, forest fires, seismic) previously collected from the partners involved in TTF1 (University of Bologna-CIRI FRAME, Molise Region, Pescara Municipality) and re-discussed during the Project Meeting in Split (24th-25th October, 2019), in order to have a basis for the drafting of the new "social media based" Civil Protection Emergency system.

1. Floods

Among natural hazards, flooding is the one that affects more people around the globe. These meteorological events can occur in many different ways (e.g. river floods, flash floods, urban floods, floods from the sea in coastal areas), and the damages they can cause strongly depend on the specific vulnerabilities of the affected areas. In the EU, *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks* (Flood Directive) [1] establishes a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Union.

Flood forecasting and warning systems are crucial flood risk management elements that need to be continuously operative in order to monitor the occurrence of dangerous hydro-meteorological conditions (the data coming from sensor networks are processed also using flood forecast models) and, therefore, the level of alert. In general, specific indicators and severity scales are defined in order to associate a precise level of danger with clear response actions to ensure preparedness. In the EU, the European Flood Awareness System [2], which is part of the Emergency Management services of the Copernicus Programme, aims to support preparatory measures before major flood events strike, providing complementary information to the Member States' national and regional civil protection authorities and informing the European Emergency Response Coordination Centre about the possibility of upcoming floods.

It is interesting to remark that potential cascading effects of a flood event, according to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [3], may include the loss of vital infrastructure, the outbreak of epidemic or epizootic events, damage to industrial facilities causing the release of chemical or radioactive substances. The latter events are named "NaTech" accidents (Natural events triggering Technological disasters). Directive 2012/18/UE ("Seveso-III" Directive), addressing the control of major accidents caused by dangerous substances, requires that NaTech scenarios involving the release of hazardous substances caused by floods in chemical and process facilities identified. The safety reports issued for the industrial sites falling under the obligation of the Directive also require the control and management of the risk deriving from such events

1.1. Current flood risk scenarios

This section aims to describe the criteria in use in Italy and Croatia, focusing on the partner regions, to identify and select flood risk scenarios for emergency planning and management, including the practices adopted. The main information collected during the survey of activity 3.1 and during the working table at the project meeting will now be presented.

In Italy, the Annex I of the National Civil Protection Department operative indications *"Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"* (10/02/2016) contains the basis for the definition of event scenarios by the Regional Authorities. More in detail, this document presents the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality" (*Tabella delle allerte e delle criticità meteo-idrogeologiche ed idrauliche)* that describes the reference event scenarios, which are marked with a colour code that represents the level of criticality (green, yellow, orange, red), and their related expected effects and damages.

According to this document, Molise, Abruzzo and Emilia Romagna, as the other Italian Regions, defined flood risk scenarios. As the differences in the procedures and risk scenario identification between the Regions are not substantial, the event scenarios concerning flood risk defined in Emilia Romagna can be considered representative and will be now presented:

- green colour code - absence of significant predictable phenomena;
- yellow colour code - localized phenomena of:
  - increase in hydrometric levels in the mayor watercourses above hydrometric threshold 1,
  - increase in hydrometric levels in the reclamation network,

  even in the absence of rainfall, the passage of river floods in large watercourses can cause hydraulic criticalities;
- orange colour code - possible widespread phenomena of:

- significant increase in hydrometric levels in the mayor watercourses above hydrometric threshold 2, with flooding of neighbouring areas and floodplain areas including the banks,
- significant increase in hydrometric levels in the reclamation network, with difficulties in water disposal and possible flooding phenomena in the surrounding areas,
- erosion of the banks, solid transport and rambling of the riverbed,
- partial or total obstructions of the spans of the bridges of the major watercourses,

even in the absence of rainfall, the passage of river floods in large watercourses can cause hydraulic criticalities;

- red colour code - Numerous and/or extensive phenomena can occur, such as:
  - river floods of the major watercourses with: exceeding the hydrometric threshold 3, extensive flooding phenomena also of areas distant from the river, widespread erosion of the banks, solid transport and rambling of the riverbed,
  - overflow of the reclamation network with flooding of the neighbouring areas,
  - levee overtopping, siphoning, levee failure, outflow, overtopping of bridges and other crossing structures, meander cut-off,
  - partial or total obstructions of bridges spans in major watercourses,

  even in the absence of rainfall, the passage of river floods into larger watercourses can cause criticalities.

The threshold values referred to are defined by the Region for each instrumented river section, and they generally identify the following situations:

- threshold 1: water levels corresponding to the complete occupation of the lean riverbed, significantly below the ground level. It indicates the passage of a not very significant flood, which could however require some hydraulic manoeuvres or preventive actions on the water courses;
- threshold 2: water levels corresponding to the occupation of the floodplain areas or of natural expansion of the watercourse, which involve embankments where present, and may exceed the terrain level. It indicates the passage of a significant flood, with widespread phenomena of erosion and solid transport;

- threshold 3: water levels corresponding to the occupation of the entire river section, close to the maximum recorded or to the bank heights. It indicates the passage of an exceptional flood, with huge and extensive erosion and solid transport phenomena.

In Croatia, flood defence is managed by Croatian Waters (*Hrvatkske Vode*), a government agency founded by the Republic of Croatia and run by the Management Board and General Managers, as regulated by the Water Act. River basin districts are the flood risk management reference territorial units. Flood risk is evaluated for each river basin district, and flood risk management plans are prepared. It is important to remark that in the definition of the scenarios, there is a difference between north and south Croatia. In fact, inland floods are more frequent, while in the coastal areas they are very rare and depend mainly on sea tides. It is also worth mentioning that risk scenarios are revised by the regions and by the competent services before the critical season.
Concerning the methods used for national risk assessment in the country [3], for every event identified, two types of scenarios need to be developed: the most likely adverse event and the event with the worst consequences. The risk type/scenario addressed in the Croatian national risk assessment for floods is the spill of inland water bodies in the Danube (while in Italy is fluvial floods).

It is possible to conclude, also considering the discussion that took place during the project meeting, that the approach to define flood risk scenarios is similar in Italy and in Croatia and that the major differences are due to the geographical characteristics of the two national territories. A summary of the information concerning the criteria in use in Italy and Croatia to identify and select flood risk scenarios for emergency planning and management is presented in the following table (figure 4).

	Italy	Croatia
RISK SCENARIOS	The "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality" (Annex I of the National Civil Protection Department operational indications) is the basis for the definition of event scenarios by the Regions. This document describes the flood reference event scenarios and their related expected effects and damages. The scenarios are marked with a colour code that represents the level of criticality (green, yellow, orange, red).	Flood defence is managed by Croatian Waters (*Hrvatkske Vode*), a government agency founded by the Republic of Croatia and run by the Management Board and General Managers, as regulated by Water Act. In the definition of the scenarios there is a difference between north and south Croatia, in fact in the inland floods are more frequent and in the coastal area floods are very rare and depend mainly from sea tides.

Fig.4: Summary of the information concerning the criteria in use in Italy and Croatia to identify and select flood risk scenarios for emergency planning and management.

1.2. Flood sensory networks

This section aims to give an overview of the existing physical sensor networks related to floods in Italy and Croatia, focusing on the partner regions. The main information collected during the survey of activity 3.1 and during the working table at the project meeting will now be presented.

In Italy, all the regions have their own hydro-meteo-pluviometric observation network. These networks carry out numerous and different monitoring functions, which can be classified into two large groups: 1) real-time use of precipitation and hydrometric level data for watercourses for the assessment of emergency situations for civil protection and land security; 2) information support functions for hydrological and climatological studies for the many aspects relating to land planning and water resource management.

In Emilia Romagna, the current regional network is the result of the integration of networks belonging to several bodies operating in the territory with different purposes. The stations of the hydrometeorological network transmit the data via radio, and these are stored in a database. Each station is associated with metadata that identifies and qualifies it (registry, type of sensors etc.).

In Molise, the sensors of the monitoring network are located throughout the region, and they measure rain, temperature, river and lake levels, atmospheric pressure, relative humidity, wind and snow level.

The data transmission system takes place with a radio network with dedicated frequencies. The data acquisition centre is at the Civil Protection Service of Molise Region. This data centre has hardware and software equipment that is useful for specific purposes.

Finally, on the municipal territory of Pescara, numerous physical sensors have been installed to constantly measure the water levels in the road underpasses and along the banks of the Pescara River. When the water level reaches a critical threshold, traffic lights are activated to warn of danger; all the physical sensors are associated with cameras that allow a visual check in real-time.

In Croatia, the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod*) is the governmental body that manages the meteorological and hydrological infrastructure as well as the national archives of meteorological and hydrological relevant data. This Service is connected with the 112 centre, the coordination body for all emergencies. This body is organized on three levels (local, regional, and national).

A summary of the information reported concerning existing physical sensor networks related to floods in Italy and Croatia is presented in the following table (figure 5).

	Italy	**Croatia**
SENSOR NETWORKS	All regions have their own hydro-meteo-pluviometric observation network. Their main monitoring functions are: 1) real-time use of precipitation and hydrometric level data, 2) information support functions for hydrological and climatological studies (land planning, water resource management).	The meteorological and hydrological infrastructure and national archives of meteorological and hydrological relevant data are managed by the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod*), which is connected with the 112 centre, the coordination body for all emergencies.

Fig.5: Summary of the information reported concerning existing physical sensor networks related to floods in Italy and Croatia.

1.3. Indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for flood risk

This section aims to describe the indicators and parameters adopted in Italy and Croatia, focusing on the Regions directly involved in the project, used to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, Annex I of the National Civil Protection Department operative indications*"Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"* (10/02/2016) contains the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality". This document describes the reference flood event scenarios (section 1.1), which are marked with a colour code that represents the level of criticality (green, yellow, orange, red), and their related expected effects and damages. Each event scenario/colour corresponds to the activation of a precise operational response (yellow-attention, orange-warning, red-alarm).

Concerning flooding phenomena, the main indicator for evaluating the hazard is the hydrometric level in the major watercourses. It is assumed that the gravity of the possible effects induced by the flood on the surrounding territories can be generally considered proportional to the level reached by the water. It is in fact impossible to know and foresee on a regional scale the criticalities of the hydrographic network and of the crossed territories that can occur during the passage of the floods. These criticalities can be found only on a local scale and through direct observation.

Molise, Emilia Romagna and Abruzzo regions, as the other Italian Regions, have defined, on the basis of these operative indications, the scale of severity for flood risk in function of the hydrometric threshold specifics defined for each regional territory. The emergency severity scales are then evaluated daily by the regional Functional Centres. This evaluation is based on data recorded by the monitoring network and weather forecasting models.

In the case of Croatia, the body competent for the definition of threshold values corresponding to the activation of precise emergency alerts is Croatian Waters (*Hrvatske Vode*). This body is also demanded to issue these warnings and coordinate emergency responses. In the Country, operational flood risk management is regulated by the National Flood Defence Plan, the Master Flood Defence Implementation Plan and the Flood Defence Implementation Plans for defended areas. In particular, the National Flood Defence Plan regulates the early warning and the communication system, while the Master Flood Defence Implementation Plan defines the four stages of flood defence depending on section-specific hydrometric levels (the criteria for their identification are contained in the same document) and the operative actions to be taken in each case. The four stages are: state of alert, regular flood defence, emergency flood defence, and state of emergency.

It is to remark that there are regions, especially in the southern part of Croatia, where Croatian Electric (*Hrvatska Elektro Privreda* – HEP) defines the thresholds and activates the warnings. This is due to the fact that this body controls the dams. For example, Croatian Electric is the first body to issue warnings for the river Cetina in Split-Dalmatia County.

It is possible to conclude that, in Italy and Croatia, the main indicator for evaluating the hazard is the hydrometric level and that severity scales are generally defined with similar approaches. A summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for floods is presented in the following table (figure 6).

	Italy	Croatia
METRICS	The reference document is the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality" (Annex I of the National Civil Protection Department operational indications) To each event scenario/colour corresponds the activation of a precise operational response: • yellow-attention, • orange-warning, • red-alarm. All regions have defined, on the basis of these operative indications, the scale of severity for flood risk in function of the hydrometric threshold specifics defined for each regional territory. The emergency severity scales are then evaluated daily by the regional Functional Centres, this evaluation is based on data recorded by the monitoring network and weather forecasting models.	The reference document is the Master Flood Defence Implementation Plan, which defines four stages of flood defence: • state of alert, • regular flood defence, • emergency flood defence, • state of emergency; depending on section specific hydrometric levels. Operative actions to be taken for each stage are described in this document. The body competent for the definition of threshold values corresponding to the activation of precise emergency alerts is Croatian Waters (*Hrvatske Vode*). This body is also the one demanded to issue these warnings and to coordinate emergency responses.

Fig.6 : Summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for floods.

1.4. Flood risk communication to public

This section aims to describe flood risk communication towards the public, traditional and none, both in Italy and Croatia (focusing on the regions directly involved in the project). These data can be helpful in the design both of the "social media based" Emergency DSS platform" (activity 3.3) and of citizens' dedicated Awareness Campaign (activity 3.4). The main information collected during the working table at the project meeting will now be presented.

In Emilia Romagna, the website "*Allerta Meteo Emilia Romagna*" (https://allertameteo.regione.emilia-romagna.it/homepage), is managed by the regional agency for territorial safety and civil protection

(*Agenzia regionale per la sicurezza territorial e la protezione civile*) and the Region itself. The website makes available to the public all the official documents concerning prevision in the Region.
To improve territorial resilience in relation to flood risk, Pescara Municipality has implemented various activities and initiatives to inform the population about risk scenarios.
Italian partners involved in TTF3 of activity 3.1 reported that, concerning their experience, the use of social media for risk communication through the official profiles of Regions and regional Civil Protection is mainly about the ongoing emergency.

In Croatia, Croatian Waters (*Hrtvatske Vode*) is the body demanded to send information concerning flood risk to the public, in particular through traditional media (TV, radio, etc.). It is to remark that this body has an official website, but this is not used for this kind of communication.

1.5. Inputs for enhancement of flood risk management

This section aims to summarise the inputs by partners concerning possible improvements of the practices in use in flood risk management, which are usually examples from their direct experience. The main information collected during the survey of activity 3.1 (TTF1) and during the first working table at the project meeting will now be presented.

- Molise Region reported that due to the ongoing climate change and the severe events reported in the Molise area, an urgent and detailed study of regional climatology is highly necessary to better assess the possible effects on the ground and define appropriate safeguards. In fact, the knowledge of the current meteo-climatic, hydrological and marine variability and the respective future scenarios is one of the starting points necessary for climate change adaptation strategies. The Civil Protection Service has nominated a technical study detailing extreme weather events. Currently, at the occurrence of a severe flood event, the Functional Centre of Molise Region drafts a technical document reporting a meteorological analysis of the conditions that lead to the event and its effects on the ground.

- EU LIFE IRIS project "Improve resilience of industry sector" developed several valuable tools for companies that intend to deal with the threats of climate change through risk analysis and the definition of climate adaptation actions to increase resilience.
- Pescara Municipality highlighted the importance of risk awareness to improve territorial resilience.

1.6. Points of interest

This section aims to summarize the inputs by partners concerning flood risk that can be useful in the design of the "social media based" Emergency DSS platform" (activity 3.3). The main information collected during the survey of activity 3.1 (TTF1) and during the first working table at the project meeting will now be presented.

- The European project "Life PRIMES-Preventing flooding risk by making resilient communities", approved under the 2014-2020 LIFE program on climate change adaptation strategies and concluded in December 2018 (both Emilia Romagna and Abruzzo regions were partners), had as its primary aim the creation of resilient communities increasingly active part in the construction of adaptation strategies and effective warning systems. The objectives have been achieved through a series of activities, inter alia: the implementation of a shared web space, the development of a process of dialogue and empowerment of the community through the preparation of local development plans for adaptation actions and the assessment of risk perception and resilience analysis. The added value of the project are the "PRIMES Guidelines" for the development of the Civic Adapt Action Plan for Communities, designed to support other local communities in the development of participatory processes aimed at improving territorial resilience with respect to flood risk.

2. Forest fires

Forest fires are recurrent phenomena in the EU, and they can impact tremendously human health, the environment, infrastructure and the economy, causing significant damages also due to cascading effects. Because of this, national emergency authorities consider them a substantial disaster risk, even for non-Mediterranean countries.

Forest fire's likelihood and severity depend mainly on climatic conditions (e.g. humidity, wind, temperature), vegetation characteristics (e.g. flammability and water content of plant species) and terrain morphology. At the same time, it is also remarkable that the majority of the fires in Europe are human-induced.

At the European Union level, it is interesting to report that the *Forest Strategy 2014-2020* [6] provides a framework for national forestry and forest-related policies promoting the concept of sustainable forest management and identifying the protection of forests from different threats, including fires, as a priority. Concerning forest fire forecasting and monitoring, the European Forest Fire Information System [7], which is part of the Emergency Management services of the Copernicus Programme, is a modular web geographic information system that provides real-time and historical information on forest fires, also monitoring their impacts, to national, regional and local Civil Protection authorities across the European Union.

Forest fires can have major disruptive impacts [3], taking into consideration the particularly relevant environmental, financial and well-being value of forest areas and woods, as well as of wildland-urban interfaces (WUI). Under extreme climatic conditions, forest fires impact ecosystem health and functions, and can cause extensive damage to life and property through the disruption of transport systems and of critical infrastructures (airports, power lines, etc.), industrial facilities and private assets. While casualties can usually be avoided, fires originate significant distress and fumes that can severely affect human health and contribute to global warming. Interactions with artificial fuels (e.g. domestic LPG tanks) and natural fuels (bushes, ornamental vegetation, wooden structures) at WUI may escalate such consequences.

2.1. Current forest fires risk scenarios

This section aims to describe the criteria in use in Italy and Croatia, focusing on the partner regions, to identify and select forest fire risk scenarios for emergency planning and management, including the practices adopted. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, the Framework Law on forest fires is L.353/2000. Article 3 attributes the task to draw up regional plans of prevision, prevention and active fight to forest fires to regions (*Piani regionali di previsione, prevenzione e lotta attiva contro gli incendi boschivi*). Article 4 assigns the implementation of prevision and prevention activities to provinces, mountain communities and municipalities. The forest fire risk scenarios are therefore defined by the regions. The basis for evaluating forest fire risk is the analysis of predisposing factors such as features of vegetation, climatic conditions, humidity, wind, temperature and morphology of the soil.

In relation to the Italian partners, Molise Region approved the update and revision of the *Regional Plan for Forecasting, Prevention and Active Fire Fighting* (AIB Plan) for the period 2018 – 2020 in 2018. This document defines the scenarios of danger and risk for forest fires in the regional territory. More in detail, forest fire risk is defined as the sum of the variables that represent the propensity of plant species to be crossed more or less easily by fire, and the risk prediction algorithm is based on a weighted additive model. The procedure performed is similar to that used in the multi-criteria analysis, in which it is necessary to solve the problem of determining a single evaluation index starting from several factors, both limiting and predisposing. Two large groups or events identify the main event scenarios: summer fires and winter fires. This choice is based on the spatial and seasonal distribution of these events.

Concerning Pescara Municipality, the hazard scenarios for forest fires are defined by the Abruzzo Region. Also in this case, a weighted additive model is used to calculate the risk, and a distinction between summer and winter forest fire events is made (distinct risk values were calculated).

It is also worth mentioning that Veneto Region uses a fire propagation model to produce dynamic risk maps.

In Emilia Romagna, the calculation of the risk for forest fires on a municipal basis is done by combining the values of potential danger attributed considering the use of soil and phytoclimatic regions, with the values obtained from the analysis of the trigger points and with the values deriving from the elaboration of the statistics of the events of each municipality. The parameters used are, among those available, those that best represent the two components of the "risk" value: the probability that the "fire" event will occur and the severity of the damage that the fire itself can cause. In the case of forest fires, the damage can be described and quantified as the combination of two fundamental components: the quality of what burns and the extent of the fire. From the combination of the data, weighted values are obtained, which lead to the representation of risk in the following classes: negligible, weak, moderate, and marked. By applying the methodology described above, it is possible to update the calculation of the risk indices with the data detected in relation to the number, extent and distribution of the fires.

In Croatia, inter-active fire hazard maps are produced by the Croatian Association for Crisis Management HUKM (*Hrvatska Udruga Kriznog Menadžmenta*), gathering a large group of information. The main sources of data are the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod)*, the European Copernicus Emergency Management Service (EMS) and Croatian Forests (*Hrvatske Šume*). These hazard maps are used by fire departments in coordination with 112. It is to remark that HUKM is a non-governmental association, and it is not considered an official channel but is nevertheless used by emergency services in support decision-making. It is also important to mention that in the definition of the scenarios, there is a difference between north and south Croatia. In fact, forest fires are more frequent in the coastal areas, and in the inland, they are very rare.

Concerning the methods used generally for national risk assessment in the country [3], for every event identified, two scenarios need to be developed: the most likely adverse event and the event with the worst consequences. For forest fire risk, the most likely scenario is described as a situation, that usually occurs in summer, where there are forest fires that occasionally threaten people and properties and that can be handled relatively quickly (from hours to some days). The worst possible scenario, instead, is described as a situation with extreme weather conditions (strong wind, high temperatures, lightning strikes and drought), which favours the development of multiple and simultaneous forest fires of considerable size in the country's coastal area. These events may threaten critical infrastructures and lead to road, rail and maritime transport congestion. To handle fires in this latter case, many resources from all the country are usually engaged, and a large population may need to be evacuated. Each scenario is assessed, showing the difference in the likelihood and specifically in the impact of each possible scenario.

It is possible to conclude, also considering the discussion that took place during the project meeting, that the approach to define forest risk scenarios cannot be considered the same in Italy and in Croatia. In Italy, a wide number of different models are used, while in Croatia the geographical characteristics of the national territory are taken into consideration in the definition of the scenarios (forest fires are more frequent in the coastal areas while they are very rare in the inland). A summary of the information concerning the criteria in use in Italy and Croatia to identify and select forest fire risk scenarios for emergency planning and management is presented in the following table (figure 7).

	Italy	Croatia
RISK SCENARIOS	The Framework Law on forest fires attributes to the regions the task to draw up regional plans of prevision, prevention and active fight to forest fires. Risk scenarios are defined by the Regions.	Inter-active fire hazard maps are produced by the Croatian Association for Crisis Management 'HUKM' gathering a large group of information; the main sources of data are the Croatian Meteorological and Hydrological Service, the European Copernicus Emergency Management Service (EMS) and Croatian Forests.

Fig.7: Summary of the information concerning the criteria in use in Italy and Croatia to identify and select forest fire risk scenarios for emergency planning and management.

2.2. Forest fire sensory networks

This section aims to give an overview of the existing physical sensor networks related to forest fires in Italy and Croatia, focusing on the partner regions. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

Regarding the Italian partner regions, there are no specific sensors for forest fires in the Molise and Emilia Romagna regions as in the municipal territory of Pescara.

In Croatia, human wildfire surveillance is mainly organized by Croatian Forests (*Hrvatske Šume*), the governmental organization responsible for the protection and exploitation of forests in state ownership. This body has 320 observer stations and 90 cameras installed in various country locations (36 in Split Dalmatia County). It is also interesting to report that, with the EU project HOLISTIC, 12 experimental cameras were installed in four counties and that now there are 140 cameras installed in all Croatia. These cameras share information with the fire departments and with Croatian Forests and they are therefore an important tool to help fire detection. Split Dalmatia County has 48 cameras for fire detection: 9 Holistic cameras in 4 locations, 36 Croatian Forest cameras in 18 locations and 3 more old IPNAS cameras in Split (Marjan Hill). All cameras are monitored 24/7 from County Crisis headquarters as a part of County fire department headquarters. Cameras are also equipped with fire detection software developed under the Holistic project. Relevant support tools for fire detection used in Croatia are "Adriafire Propagator" (it gives live information when a fire is detected in a precise area) and "Adriafire Risk" (for smoke detection).

A summary of the information reported concerning existing physical sensor networks related to forest fires in Italy and Croatia is presented in the following table (figure 8).

	Italy	Croatia
SENSOR NETWORKS	There are no specific sensors for forest fires in Molise and Emilia Romagna regions as in the municipal territory of Pescara.	Croatian Forests (*Hrvatske Šume*), the governmental organization responsible for protection and exploitation of forests in state ownership, organizes the human wildfires surveillance. 140 experimental cameras, which share information with the fire departments and Croatian Forests, were installed in all the Country to help fire detection.

Fig.8: Summary of the information reported concerning existing physical sensor networks related to forest fires in Italy and Croatia.

2.3. Indicators and parameters to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures for forest fire risk

This section aims to describe the indicators and parameters adopted in Italy and Croatia, focusing on the partner regions, to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, the Prime Minister defines the timing of the AIB campaign (*Campagna Anti Incendio Boschivo*) every year and gives operational guidelines to the Regions and to the competent Ministries for the prevention and management of forest fires.

Regarding the Italian participants in this task force, Molise has defined the scale of severity for forest fire risk articulated in 4 levels: green, yellow, orange and red, depending on the specifics defined for the regional territory, with the support of numerical modelling (RISICO) made available by the National Department of Civil Protection. The emergency severity scale is evaluated in the period from June to September by the Functional Centre of Molise Region, which is responsible for monitoring and alerting activity.

The Municipality of Pescara, located in the Abruzzo Region, defined forest fire parameters on the basis of the presence of areas that have already been involved in fires, according to national and regional legislation. Concerning the intervention model, the example of Emilia Romagna will be reported. The intervention model is divided into successive phases in relation to the level of danger, which timely marks the growth of the level of attention and use of the tools and human and financial resources that are put in place. Two periods are defined:

1) an ordinary period (during which the danger of fires is limited or non-existent);
2) a period of intervention (during which the danger of forest fires is high).

During the intervention period, increasing operational phases are activated, proportionate to the forecasting aspects, divided into the following:

- attention phase (indicatively from February to April and from June to September);
- pre-alarm phase (which coincides with the state of serious danger);

- alarm phase (reporting of fire sighting);
- containment, extinguishing and reclamation phase (fire extinction).

In Croatia, the indicators and parameters to define emergency severity scales are elaborated by the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod)*.

A summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for forest fires is presented in the following table (figure 9).

	Italy	**Croatia**
METRICS	The Prime Minister defines every year the timing of the AIB campaign (*Campagna Anti Incendio Boschivo*) and gives operational guidelines to the Regions and to the competent Ministries for the prevention and the management of forest fires. The Framework Law on forest fires (L.353/2000) attributes to ➢ regions the task to draw up regional plans of prevision, prevention and active fight to forest fires ➢ provinces, mountain communities, municipalities the task to implement prevision and prevention activities	In Croatia the indicators and parameters to define emergency severity scales are elaborated by the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod*).

Fig.9: Summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for forest fires.

2.4. Forest fire risk communication to public

This section aims to describe forest fire risk communication towards public, traditional and none, both in Italy and Croatia (focusing on the regions directly involved in the project). These data can be useful in the design both of the "social media based" Emergency DSS platform" (activity 3.3) and of citizens dedicated Awareness Campaign (activity 3.4). The main information collected during the working table at the project meeting will now be presented.

Concerning Italy, it was reported by Veneto Region that specific prescriptions are issued (e.g. not smoking in the forests) during the season at "maximum risk" not only to avoid fires but also to increase public awareness.
Moreover, in order to improve territorial resilience in relation to forest fire risk, Pescara Municipality has implemented various activities and initiatives in order to inform the population on risk scenarios.
Italian partners involved in TTF3 of activity 3.1 reported that, concerning their experience, the use of social media for risk communication through the official profiles of Regions and regional Civil Protection is mainly about the ongoing emergency.

In Croatia, traditional communication concerning ongoing wildfires through traditional media (TV, radio, etc.) is very effective, especially in the wildfire-prone areas. Moreover, the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod)* releases information to the public concerning wildfire risk and ongoing fires through its social profiles. It is moreover relevant to report that, in coastal cities, interactive panels were installed in order to inform the public in relation to the level of forest fire risk. These panels are directly connected with the Croatian Meteorological and Hydrological Service (DHMZ).

2.5. Inputs for enhancement of forest fire risk management

This section aims to summarize the inputs by partners concerning possible improvements, which are usually examples from their own direct experience, of the practices in use in forest fire risk management. The main information collected during the survey of activity 3.1 (TTF1) and during the first working table at the project meeting will now be presented.

- Molise Region suggests that effective actions for the enhancement of the protection of citizens and assets could be the improvement of the forecasting of vegetation status and the boost of forest fire risk awareness in the population since the phenomenon of forest fires is strongly influenced by human activity and weather conditions. In the Region, with the European cooperation project "To Be Ready" (IT-AL-ME), an experimental network for the evaluation of phenology and for the improvement of analyses is planned. This network includes some cameras with images in the visible for the monitoring of sensitive areas and the acquisition of satellite images to predict the danger of forest fires.

- The University of Bologna-CIRI FRAME proposes to further evaluate, mainly for potential early fire detection and damage assessment, the use of multispectral images periodically taken from satellites or from planned UAV flights over sensible areas.
- Pescara Municipality highlighted the importance of risk awareness to improve territorial resilience.

3. Earthquakes

Earthquakes are unpredictable events. In fact, it is impossible with the current scientific tools to determine when and where the next earthquake is going to occur and how large its magnitude will be. Nowadays, the only possible seismic previsions are of a statistical nature, and they are based on past seismicity.

The identification of earthquake-prone areas and of damage scenarios is of great importance for seismic risk management. Moreover, since seismicity is a feature of the site and therefore cannot be changed, it is crucial to strengthen preparedness, act on the vulnerability of buildings, improve their resilience, and plan appropriate response operations in order to reduce the severity of damages on communities, infrastructures, economy and the environment.

The reference document for seismic prevention concerning the vulnerability of buildings in the EU is Eurocode 8 (*EN 1998: "Design of structures for earthquake resistance"* [8]). Its provisions apply, as stated in the document, to the design and the construction of buildings and civil engineering works in seismic regions. Its purpose is to ensure that human lives are protected in the event of earthquakes, that damage is limited, and that structures important for civil protection remain operational.

Earthquakes' possible cascading effects may strongly affect the built environment. As the disruption of strategic infrastructure can seriously aggravate emergency situations, it is crucial to assess their vulnerability. With respect to NaTech scenarios triggered by earthquakes, Directive 2012/18/UE ("Seveso-III" Directive), addressing the control of major accidents caused by dangerous substances, requires that such scenarios are identified and characterized. The safety reports issued for the industrial sites falling under the obligation of the Directive also require the control and management of the risk deriving from such events.

3.1. Current seismic risk scenarios

This section aims to describe the criteria currently applied in Italy and in Croatia, focusing on the partner Regions, to identify and select seismic risk scenarios for emergency planning and management, including the practices adopted. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, the national territory is classified into four risk zones (O.P.C.M. n.3274 / 2003, *Primi elementi in materia di criteri generali per la classificazione sismica del territorio nazionale e di normative tecniche per le costruzioni in zona sismica*). Each zone is given a value of the seismic action useful for planning preventive and response measures in case of an earthquake, expressed in terms of maximum acceleration on rock ('a_g'). More in detail, the zones are defined as follows

- seismic zone 1: $a_g > 0,25$;
- seismic zone 2: $0,15 < a_g < 0,25$;
- seismic zone 3: $0,05 < a_g < 0,15$;
- seismic zone 4: $a_g < 0,05$.

Area 4 includes all the territories excluded from any seismic classification.
O.P.C.M. 3274/2003 states the general principles according to which the regions, to which the state has delegated the adoption of the seismic classification of the territory, compile the list of municipalities with the relative attribution to one of the four zones.
Concerning the Italian partners of the project, in Emilia Romagna, the seismic action necessary for the design and the implementation of interventions to prevent seismic risk is defined for each site starting from the seismic hazard parameters provided by the technical standards for buildings. Alternatively, the use of accelerograms is permitted, provided that they are correctly commensurate with the local seismic hazard of the build area considered. During the seismic event, the scenario is obtained through the quick definition of the exposed elements falling within the affected area, which is determined with various techniques as the elaboration of the instrumental measurements of the seismic shaking and its effects on the buildings, fundamental are also the damage communications from the operating structures of the regional Civil Protection system.
The Municipality of Pescara based its emergency planning concerning earthquakes on the values defined at the national level and on the regional studies of seismic microzonation.

In Croatia, the Ministry of Construction (*Ministarstvo Graditeljstva*) is the main body when it comes to seismic risk. The Geophysical Institute and the Seismological Service "Andrija Mohorovcic", which is part of the Faculty of Natural Sciences and Mathematics (*Prirodoslovno Matematički Fakultet – PMF*) of Zagreb, produced seismological maps related to the return period and the Peek Ground Acceleration (hazard maps). HUKM (*Hrvatska Udruga Kriznog Menadžmenta*) used those hazard maps and combined them with vulnerability and historical data order to produce some form of risk maps.

Concerning the methods generally used for national risk assessment in the country [3], the risk type/scenario addressed in the Croatian national risk assessment for seismic risk is an earthquake in the city of Zagreb. The likelihood of this risk is small, while the possible impacts are catastrophic. In the assessment, climate change is not considered. Concerning cascading effects, flooding is part of a composite risk scenario.

A summary of the information concerning the criteria in use in Italy and Croatia to identify and select seismic risk scenarios for emergency planning and management is presented in the following table (figure 10).

	Italy	**Croatia**
RISK SCENARIOS	O.P.C.M. 3274/2003: • classifies the national territory into four risk zones; each zone is given a value of the seismic action, expressed in terms of maximum acceleration on rock ('a_g'), useful for the planning of preventive and response measures in case of earthquake; • states that regions have to classify the seismic risk of the territory, assigning a value to each municipality.	The Geophysical Institute and the Seismological Service "Andrija Mohorovcic", which is part of the Faculty of Natural Sciences and Mathematics of Zagreb, produced seismological maps for the return period and Peek Ground Acceleration (hazard maps). HUKM used those hazard maps and combined them with vulnerability and historical data order to produce some form of risk maps.

Fig.10: Summary of the information concerning the criteria in use in Italy and Croatia to identify and select seismic risk scenarios for emergency planning and management.

3.2. Seismic sensory networks

This section aims to give an overview of the existing physical sensor networks related to earthquakes in Italy and Croatia, focusing on the partner regions. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, the expertise in seismic monitoring is attached to the National Institute of Geophysics and Volcanology (*INGV, Istituto Nazionale di Geofisica e Vulcanologia*) and to the National Department of Civil Protection. The main sensor networks taken as a reference from the Regional Operational Centres for the definition of seismic scenarios are the National Accelerometric Network (RAN, *Rete Accelerometrica Nazionale*) and the Network of the Seismic Observatory of Structures (OSS, *Osservatorio Sismico delle Strutture*), both managed by the Civil Protection Department.

RAN is a monitoring network that records the effects of an earthquake in terms of soil accelerations. It consists of 580 digital stations, permanent and temporary. Each station is equipped with a triaxial accelerometer that allows the acquisition of accelerometric measurements in the north-south, east-west and vertical directions, a digitizer, a modem/router with an antenna to transmit the digitized data via GPRS and a GPS receiver to associate the data with the universal UTC time and to measure the latitude and longitude of the station. The data flow to the central server of the headquarters of the Department of Civil Protection, where they are acquired and processed automatically to obtain an estimate of the main parameters that describe the seismic shock.

The national OSS network is made up of 160 publicly owned buildings falling into municipalities classified mostly in seismic zone 1 and 2. The OSS allows the assessment of the damage caused by an earthquake to the monitored structures. This assessment can also be extended to similar structures that fall within the affected area, thus providing helpful information for the civil protection activity immediately after an earthquake. This monitoring system records the movements of the terrain and of the structures and immediately sends the recorded data to the central OSS server in Rome. The server automatically processes the entries flowing from all the affected structures, producing a summary report with the maximum values and some descriptive parameters which allow to evaluate the incoming earthquake, the vibrations of the structure and the relative state of damage. Furthermore, in the hours immediately following a severe earthquake, a temporary network consisting of simplified monitoring systems is installed in the epicentre area. In this case, the monitored structures are mainly the buildings designated for coordinating emergency management interventions.

In Croatia, the Croatian Seismographic Network is operated by the University of Zagreb, in particular by the Department of Geophysics (*Seizmološka Služba*). In the country, there are around 30 seismological stations that are rotated on occasion (Brijuni, Dubrovnik, Dugi Otok, Hvar, Kalnik, Kijevo, Lobor, Lastovo, Makarska, Morići, Moslavačka Gora, Ozalj, Puntijarka, Rijeka, Zagreb, Žirje, etc.).

A summary of the information reported concerning existing physical sensor networks related to seismic events in Italy and Croatia is presented in the following table (figure 11).

	Italy	**Croatia**
SENSOR NETWORKS	In Italy, the expertise on seismic monitoring is demanded to the National Institute of Geophysics and Volcanology (INGV) and the National Department of Civil Protection. The main sensor networks, taken as a reference from the Regional Operational Centres for the definition of seismic scenarios, are the • National Accelerometric Network (RAN, *Rete Accelerometrica Nazionale*) • Network of the Seismic Observatory of Structures (OSS, *Osservatorio Sismico delle Strutture*), data managed by the Civil Protection Department.	The Croatian Seismographic Network is operated by the University of Zagreb, in particular by the Department of Geophysics (*Seizmološka Služba*). In the country there are around 30 seismological stations that are rotated on occasion.

Fig.11: Summary of the information reported concerning existing physical sensor networks related to seismic events in Italy and Croatia.

3.3. Indicators and parameters to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures for seismic risk

This section aims to describe the indicators and parameters adopted in Italy and Croatia, focusing on the partner regions, to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures. The main information collected during the survey of activity 3.1 (TTF1) and during the working table at the project meeting will now be presented.

In Italy, the parameters that define the physical intensity (magnitude) and the macroseismic intensity of an earthquake are elaborated and defined by INGV and by the Civil Protection Department. It should also be remarked that the activation threshold for a detailed study of the seismic phenomenon is set at magnitude 4. Furthermore, in Italy, a great effort was made for the seismic classification of the national territory (section 3.1). This classification is based on historical data (intensity, frequency and location of past earthquakes) and is the natural basis for the planning of emergency responses.
It is interesting to report that in Emilia Romagna, as part of the agreement with CIRI Edilizia e Costruzioni, the "Ground Motion Analysis Toolbox" software was developed. This software allows the calculation of the main intensity indices of a seismic event and the response spectra and the evaluation of the presence of impulsive characteristics in the recordings. This Toolbox is used at the Emilia Romagna Regional Operative Centre to define emergency seismic scenarios. Among the intensity measurements taken into consideration, there are: PGA (peak ground acceleration), EPA (effective peak acceleration), I_c (characteristic intensity), EPV (effective peak speed), SI_H (Housner spectral intensity), PGV (peak ground velocity), PGD (peak ground displacement). Further assessments, which allow the evaluation of the severity of the effects of an earthquake on structures, are conducted in the region by analysing the extent of inter-floor displacements for the buildings of the seismic observatory of structures, which constitute a particularly reliable index of damage.

For Croatia, no specific information on the topic was collected. Although, it was reported that, according to the organization of the national Civil Protection system, when a state of major accident and catastrophe is declared, the civil protection headquarters of the local and regional self-government units and the Civil

Protection Headquarters of the Republic of Croatia undertake all tasks of harmonizing the operation of the civil protection system operational forces in mitigating and eliminating the consequences. The decision on the activation and mode of operation of the headquarters shall be made by the Chief of Staff.

A summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for seismic events is presented in the following table (figure 12).

	Italy	Croatia
METRICS	The thresholds that define the physical intensity (magnitude) and the macroseismic intensity of an earthquake are elaborated and defined by • INGV • Civil Protection Department. The activation threshold for a detailed study of the seismic phenomenon is set at magnitude 4.	No specific information regarding seismic risk was collected. It was reported that when a state of major accident and catastrophe is declared, the decision on the activation and mode of operation of the headquarters shall be made by the Chief of Staff.

Fig.12: Summary of the information reported concerning the indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures for seismic events.

3.4. Seismic risk communication to public

This section aims to describe flood risk communication towards public, traditional and none, both in Italy and Croatia (focusing on the regions directly involved in the project). These data can be useful in the design both of the "social media based" Emergency DSS platform" (activity 3.3) and of citizens' dedicated Awareness Campaign (activity 3.4). The main information collected during the working table at the project meeting will now be presented.

Concerning Italy, it is worth mentioning that Veneto Region is developing an app to allow the Civil Protection volunteers to send prompt alerts in case of an earthquake (Interreg Project "ARMONIA").
Moreover, in order to improve territorial resilience in relation to flood risk, Pescara Municipality has implemented various activities and initiatives in order to inform the population on risk scenarios.

Italian partners involved in TTF3 of activity 3.1 reported that, concerning their experience, the use of social media for risk communication through the official profiles of Regions and regional Civil Protection is mainly about the ongoing emergency.

3.5. Inputs for enhancement of seismic risk management

This section aims to summarize the inputs by partners concerning possible improvements, which are usually examples from their own direct experience, of the practices in use in seismic risk management. The optimisation of emergency management and the improvement of communication in the immediacy of the event are of great importance as the seismic event is not predictable with current technologies. Moreover, to reduce seismic risk, it is crucial to strictly regulate urbanization, especially in earthquake-prone areas, and to follow the provision of Eurocode 8 for the design and construction of new buildings. The main information collected during the survey of activity 3.1 (TTF1) and during the first working table at the project meeting will now be presented.

- Molise Region highlighted the importance of the studies of Seismic Microzonation to identify the local conditions on a sufficiently large scale (municipal or sub-municipal). These studies allow dividing the territory into zones with different behaviour in the event of an earthquake (local seismic response) and can improve emergency planning.
- In Emilia-Romagna, in application to the Regional law 1661/09, several categories of structures, including industrial facilities and storages of hazardous chemical substances and hazardous fuels, should be inspected and verified in order to assess their resistance to seismic action and their safety in the case of an earthquake. Provincial Civil Protection Plans (PPPC, *Piani Provinciali di Protezione Civile*) were prepared, indicating the specific structures in each category that should be verified.
- Dalmatia County and Molise Region reported that strategic public buildings were briefly monitored in order to define a better response in case of an earthquake during the European Cooperation project "READINESS, Resilience enhancement of Adriatic basin from fire and seismic hazards" (IT-HR). In Dalmatia County, 15 schools were evaluated.
- Pescara Municipality highlighted the importance of risk awareness to improve territorial resilience.

3.6. Points of interest

This section aims to summarize the inputs by partners concerning flood risk that can be useful in the design of the "social media based" Emergency DSS platform" (activity 3.3). The main information collected during the survey of activity 3.1 (TTF1) and during the first working table at the project meeting will now be presented.

- Molise Region is participating in the draft of a project to be submitted to the H2020 program (MOSIS) which aims to create a DSS platform to centralize information from conventional sensors (accelerometers, etc.) and unconventional (images from drones, accelerometers on smartphones, etc.) for the assessment of the damage scenario following a seismic event.
- Veneto Region is developing an app to allow the Civil Protection volunteers to send prompt alerts in case of an earthquake (Interreg Project "Armonia").

Conclusions

In this report, the information collected from the partners engaged in TTF1 of activity 3.1 (University of Bologna - CIRI FRAME, Molise Region, Pescara Municipality) and during the first working table at the project meeting in Split (24^{th}-25^{th} October, 2019) regarding the techniques and metrics to model and represent risk scenarios for the selected target risks (floods, forest fires, seismic) were evaluated and summarized.

This document provides an overview of the methods and practices adopted in Italy and Croatia and gives some suggestions for enhancing current practices. It aims to be a starting point to pursue the goals of activity 3.3, "*Design of hardware and software specifications of "social media based" Emergency DSS platform*".

References

[1] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks *(*http://data.europa.eu/eli/dir/2007/60/oj)

[2] European Flood Awareness System – official page https://www.efas.eu/european-flood-awareness-system-efas

[3] European Commission,*Overview of Natural and Man-made Disaster Risks the European Union may face, European Commission staff working document*, 2017 (https://ec.europa.eu/echo/sites/echo-site/files/swd_2017_176_overview_of_risks_2.pdf)

[4] V. Cozzani, M. Campedel, E. Renni, E. Krausmann: *"Industrial accidents triggered by flood events: analysis of past accidents"*. Journal of Hazardous Materials 175:501-509 (2010)

[5] E. Krausmann, A.M. Cruz, and E. Salzano, *"Natech Risk Assessment and Management"*, Elsevier: Amsterdam (2016)

[6] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A new EU Forest Strategy: for forests and the forest-based sector*, 20/9/2013

[7] European Forest Fire Information System, official webpage - https://emergency.copernicus.eu/mapping/ems/early-warning-systems-efas-and-effis

[8] EN 1998: "Design of structures for earthquake resistance"

Data Sources

www.protezionecivile.it

D.Lgs. 112/98*"Conferimento di funzioni e compiti amministrativi dello Stato alle regioni ed agli enti locali, in attuazione del capo I della legge 15 marzo 1997, n. 59"*

D.Lgs. n.1/2018*"Codice della protezione civile"*

Floods

Direttiva del Presidente del Consiglio dei Ministri 27/02/2004 *"Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico e idraulico ai fini di protezione civile"* e s.m.i.

Indicazioni operative del Dipartimento di Protezione Civile Nazionale del 10 febbraio 2016 recanti *"Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"*

D.Lgs. 49/2010 "*Direttiva Alluvioni"*

https://allertameteo.regione.emilia-romagna.it/weballerte-theme/guide_mappa/TABELLE_SCENARI.pdf (Emilia-Romagna Region)

https://www.arpae.it/dettaglio_generale.asp?id=229&idlivello=32 (Emilia-Romagna Region)

https://allertameteo.regione.emilia-romagna.it/homepage/ (Emilia-Romagna Region)

D.G.R. 962/2018 "*Documento per la gestione organizzativa e funzionale del sistema regionale di allertamento per il rischio meteo idrogeologico, idraulico, costiero ed il rischio valanghe, ai fini di protezione civile"* (Emilia-Romagna Region)

L.R. 7/2004"Disposizioni in materia ambientale. Modifiche ed integrazioni a leggi regionali" (Emilia Romagna Region)

L.R.1/2005 *"Nuove norme in materia di Protezione Civile e Volontariato. Istituzione dell'Agenzia Regionale di Protezione Civile"*(Emilia-Romagna Region)

www.ildistrettoidrograficodellappenninomeridionale.it(Molise Region)

www.abtevere.it/node/718?q=node/718(Molise Region)

www.protezionecivile.molise.it(Molise Region)

https://www.regione.abruzzo.it/ (Abruzzo Region)

http://www.comune.pescara.it/internet/index.php?codice=1 Abruzzo Region)

http://www.lifeprimes.eu

http://www.lifeiris.eu/

https://meteo.hr/o_nama.php

https://ec.europa.eu/environment/water/flood_risk/pdf/fhrm_reports/HR%20FHRM%20Report.pdf

Zoran Đuroković, M.Sc.C.E. Croatian Waters ,*"Active flood defence in Croatia: regulatory framework, roles and responsibilities"*, Workshop on Flood Risk Management measures & links to EU WFD, November 11-12, 2015, Zagreb, Croatia (http://www.savacommission.org/dms/docs/dokumenti/events/workshop_on_flood_risk_management_measures_and_links_to_eu_wfd/presentations/15.pdf)

Forest fires

L. 353/2000*"Legge-quadro in materia di incendi boschivi"*

D.G.R.1172/2017 "Approvazione del Piano regionale di previsione, prevenzionee lotta attiva contro gli incendi boschivi, ex L.353/00 (period2017-2021) (Emilia-Romagna Region)

www.regione.molise.it (Molise Region)

www.protezionecivile.molise.it (Molise Region)

https://protezionecivile.regione.abruzzo.it/index.php/piano-a-i-b (Abruzzo Region)

https://www.hrsume.hr/index.php/hr/category-table/125-sume/zastita-suma-od-pozara

Seismic risk

www.ingv.it

www.protezionecivile.molise.it (Molise Region)

www.regione.molise.it (Molise Region)

https://www.italy-croatia.eu/web/readiness

https://protezionecivile.regione.abruzzo.it/index.php/rischio-sismico (AbruzzoRegion)

https://www.fdsn.org/networks/detail/CR

Analysis of existing normative rules and procedures and their level of uniformity

Report No.2

Summary

Summary 1
Introduction 2
1. The national Civil Protection emergency management legislative frameworks in Italy and Croatia ... 6
2. Current Civil Protection management legislation concerning floods 10
2.1. National level 11
2.2. Regional /local level 12
3. Current Civil Protection management legislation concerning forest fires 14
3.1. National level 14
3.2. Regional/local level 15
4. Current Civil Protection management legislation concerning seismic risk 17
4.1. National level 17
4.2. Regional/local level 19
Conclusions 20
References 21
Data sources 22
Floods 22
Forest fires 22
Seismic risk 22
Appendix I – The privacy issue 23

Introduction

This report is part of the E-CITIJENS project, funded by Italy – Croatia Inter-Reg program. The main aim of the project is to increase the safety of the Italian and Croatian Adriatic basin in relation to natural and man-made disasters by developing a cross-border model of an emergency management system integrating risk scenarios data from sensor networks and regulatory frameworks and the information voluntarily provided via social media by the public (citizen journalism). Three risk areas are primarily considered: floods, forest fires, and seismic.

Work package 3 (WP3) consists in four main activities that have been planned in order to achieve this goal. They are summarized in figure 1.

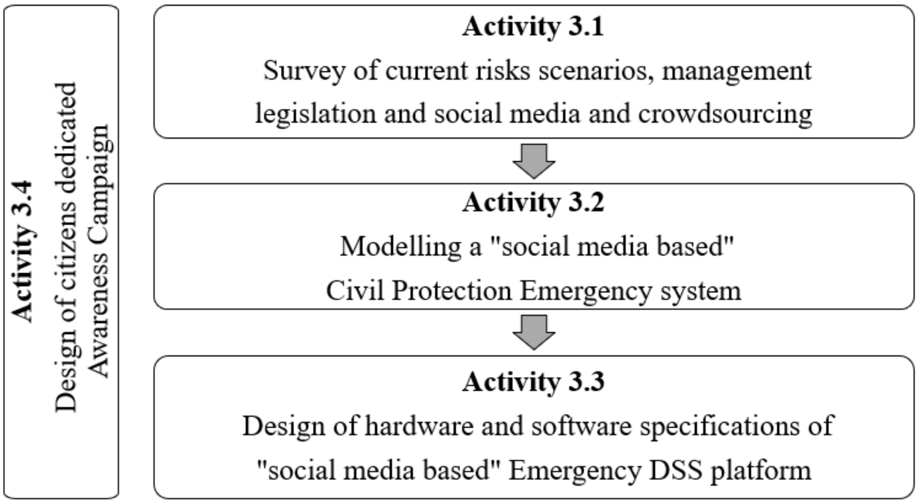


Fig.1: Overview of WP3 activities.

Activity 3.1, already concluded, consisted of the survey and assessment, besides best practices, of knowledge and experience from previous projects in Italy and Croatia concerning current risk scenarios, current civil protection management legislation and social media and crowdsourcing. A thematic task force (TTF) was set up for each of these three topics. In particular, TTF1 concerned risks scenarios, TTF2 risk management legislation, and TTF3 social media and crowdsourcing (as shown in figure 2).

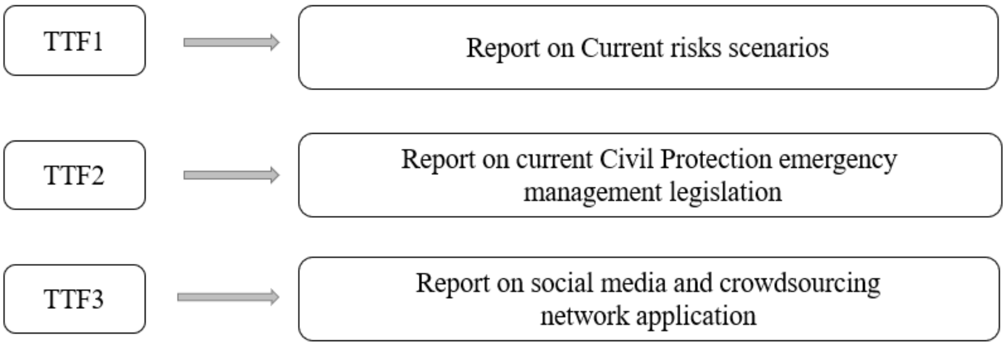


Fig.2: Activity 3.1 overview.

These three reports were elaborated on the basis of the information collected in three separate surveys that took place in July and August 2019, where all the recipients and the partners involved in each task force were asked to answer specific questions in relation to their knowledge and experience concerning the topics investigated. The information collected was discussed during the Project Meeting in Split (24th-25th October, 2019) in three working tables, that opened actually activity 3.2, in order to integrate it and to set the basis for possible future implementations.

The main aim of Activity 3.2 is a consistency analysis of the collected data in order to create a solid base for the modelling of a "social media based" Civil Protection Emergency system.

The main working areas of this activity are the following:

1) reclassification of risk scenarios and of their operational management, on the basis of common metrics and shared procedures, including cartographical representation,
2) analysis of existing normative rules and procedures and their level of uniformity,
3) "social Media and crowdsourcing" hazardous events information flows, quality and location of information, semantic ontologies specific for each risk and fakes identification criteria (common "language").

To better understand the relations between activity 3.1 and activity 3.2, an explanatory scheme is presented in figure 3.

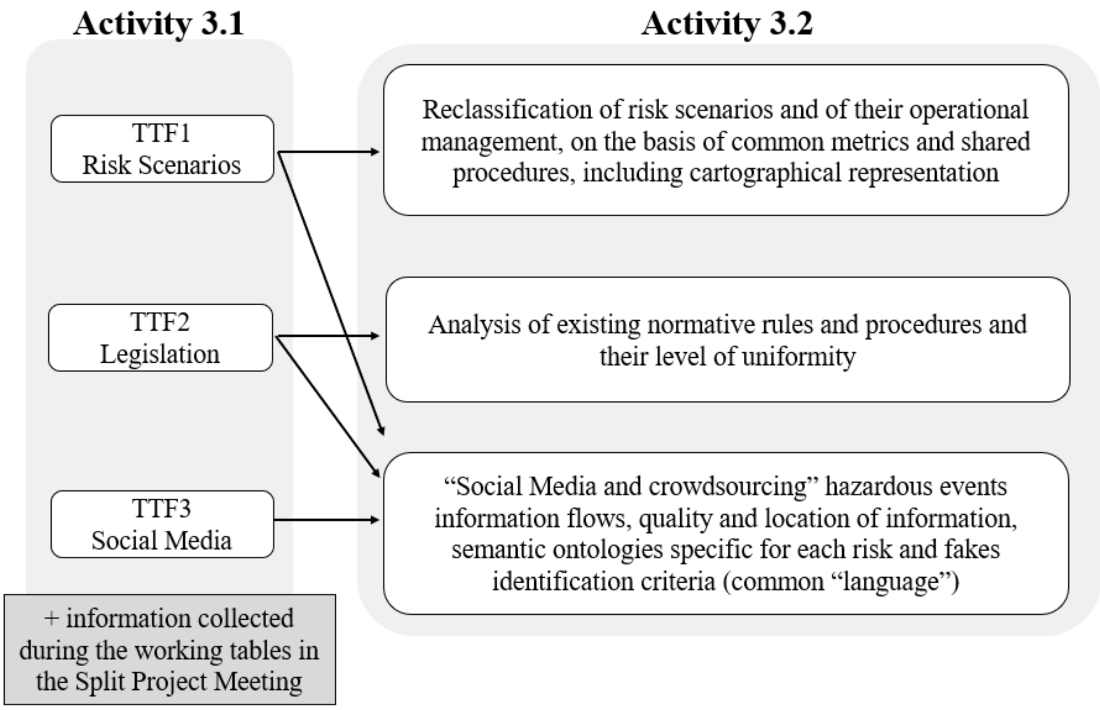


Fig.3: Relations between activities 3.1 and 3.2.

Is it clear that the three task forces of Activity 3.1 are all fundamental for the third report of activity 3.2, which has been prepared by the University of Split, Faculty of Civil Engineering, Architecture and Geodesy.

The current report concerns working area 2 of activity 3.2 and aims to present, integrated and reorganised, the information concerning the existing normative rules and procedures for the selected target risks of the project (floods, forest fires, seismic) previously collected from the partners involved in TTF2 (Adriatic Ionian Euroregion, Molise Region, Pescara Municipality) and re-discussed during the Project Meeting in Split (24th-25th October, 2019), in order to have a basis for the drafting of the new "social media based" Civil Protection Emergency system.

In Appendix I a focus on the privacy issues related to the use of data collected from the most used social media (e.g. Facebook, Twitter) will be presented. Due to the complexity of the topic, this part needs further investigation.

1. The national Civil Protection emergency management legislative frameworks in Italy and Croatia

This section describes the national Civil Protection emergency management legislative frameworks in Italy and Croatia. The main information collected during the survey of activity 3.1 and during the working table at the project meeting will now be presented.

The civil protection matter in the Italian state is a competing subject, according to the provisions of art. 117 of the Italian Constitution. In Italy, the Civil Protection System was established in 1992 (L. 225/1992*, Istituzione del Servizio Nazionale di protezione civile*). This law distinguishes, for the purposes of civil protection activities, three types of events:

- natural events or events connected with human activity that can be faced through actions that can be implemented by the individual bodies and administrations competent in the ordinary way (local level),
- natural events or events connected with human activity that, by their nature and extension, involve the coordinated intervention of several competent bodies or administrations in an ordinary way (provincial and regional level),
- natural disasters or connected with human activity that, due to their intensity and extension, must be faced with means and extraordinary powers to be used during limited and predefined periods of time (national and international level).

The national reference standard is Legislative Decree 1/2018, Civil Protection Code (*Codice di Protezione Civile*) which is divided into 7 parts. The first part describes the aims, activities and composition of the National Civil Protection Service, which sees citizens, institutions and public and private structures at all levels committed and involved in the pursuit of the objectives of safeguarding the integrity of the life, assets, settlements and the environment. The second part describes the organization of the National Civil Protection Service, starting from the type of civil protection events. The third part describes the risk prevention and prevention activities, where a strategic role is played by the alert system organized at regional and national levels through the network of Functional Centres. The fourth part deals with emergencies of national importance, and the activation of the National Civil Protection Service following the declaration of the "state of emergency", the fifth deals with the participation of citizens and volunteers organized for civil protection activities, and the sixth collects measures and organizational and financial tools aimed at the realization of civil protection activities and the seventh contains transitional and final provisions.

In Croatia, the Protection and Rescue Act (NN 174/04, 79/07, 38/09, 127/10, *Zakon o zaštiti i spašavanju*) is the first systematic law in the country addressing protection and rescue activities. It introduced three levels in the Croatian Civil Protection organization:

- central level,
- county level (*županija*, plus the city district of Zagreb*)*,
- town or municipality level (*općina* and *grad*).

The first is represented by the National Protection and Rescue Directorate, the second by the county prefects and the latter by the mayors.
This act was substituted by the Law on Civil Protection System (NN 82/2015 and 118/18, *Zakon o Sustavu Civilne Zaštite*), the national reference standard. It was reported during the working table that in Croatia new laws concerning civil protection and firefighting will be published soon, and more responsibilities will be given to counties and municipalities. A scheme of the Italian and Croatian Civil Protection emergency management legislative frameworks is presented in the next page (figure 4).

These regulations constitute the framework of the Civil Protection systems in Italy and Croatia; they are based on the same principle of subsidiarity, and there is a common multilevel governance of emergencies. In Italy, the Department of Civil Protection is the coordination body of the Italian National System of Civil Protection. This System involves many different actors from the public sector (government, ministries, regions, provinces, municipalities, operational bodies, etc.), the scientific and academic world (universities, research institutes, etc.) and the civil society (volunteers, private companies).
In Croatia, the following participants are implementing measures and activities in the civil protection system: the Croatian Government, the Ministry of the Interior (the central state administration body competent for civil protection), state administration bodies and other state bodies, Croatian armed forces and police and units of local and regional self-government. As reported during the working table, the main

operational forces of the Croatian civil protection system are the operational firefighting forces (*operativne snage vatrogastva*), the operational forces of the Croatian Red Cross (*operativne snage Hrvatskog Crvenog križa*) and the Croatian Mountain Rescue Service (*operativne snage Hrvatske gorske službe spašavanja*).

In both countries, there are teams of volunteers registered in local databases that can give support, coordinated by the Civil Protection, in case of emergency.

Italy	Croatia
The Civil Protection System was established in 1992 (**L. 225/1992, *Istituzione del Servizio Nazionale di protezione civile***). This law distinguishes, for the purposes of civil protection activities, three types of events: • natural events or events connected with human activity that can be faced through actions that can be implemented by the individual bodies and administrations competent in the ordinary way (**local level**) • natural events or events connected with human activity that, by their nature and extension, involve the coordinated intervention of several competent bodies or administrations in the ordinary way (**provincial and regional level**), • natural disasters or connected with human activity that due to their intensity and extension must, with immediate intervention, be faced with means and extraordinary powers to be used during limited and predefined periods of time (**national and international level**). The national reference standard is **Legislative Decree 1/2018, Civil Protection Code (Codice di Protezione Civile).**	The ***Protection and Rescue Act (NN 174/04, 79/07, 38/09, 127/10, Zakon o zaštiti i spašavanju)*** is the first systematic law in the country addressing protection and rescue activities. It introduced three levels in the Croatian Civil Protection organization: • central level, • county level (*županija*, plus the city district of Zagreb), • town or municipality level (*općina* and *grad*). This act was substituted by the **Law on Civil Protection System (NN 82/2015 and 118/18, *Zakon o Sustavu Civilne Zaštite*)**, the actual national reference standard.

Fig.4: Framework of the Civil Protection systems in Italy and Croatia.

As the first thematic area of activity 3.2 concerns the reclassification of risk scenarios and their operational management on the basis of common metrics and shared procedures, it is helpful to underline that these regulations give also guidelines for the definition of risk scenarios and, more in general, for risk assessment. During the working table was stressed that in Italy regions can make laws on civil protection topics since 2001, but this is not the case for Croatia. Therefore, each Italian region has different organizations and procedures regarding the prevision and prevention of emergency situations. This fact needs to be taken into account while designing the platform.

2. Current Civil Protection management legislation concerning floods

Among natural hazards, flooding is the one that affects more people around the globe. Due to the intensification of flood phenomena and the increase in their severity, ascribable to the continuous demographic and economic development and climate change, their impacts on people, infrastructure and the environment can be highly significant. Therefore, there is a considerable civil protection interest in reducing flood risk and in establishing appropriate feedback mechanisms to minimize as much as possible their frequency of occurrence and their impacts. All risk management actions concerning floods need to be strictly coordinated and organized, defining clear responsibilities at all levels (national, regional, local) through a solid legal framework.

In EU, Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (Flood Directive)[1] establishes a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Union. The Directive requires the Member States to produce:

- Preliminary Flood Risk Assessments (article 4) to identify the areas, more in particular river basin districts or other units of management, with significant flood risk;
- flood hazard maps and flood risk maps (article 6) at river basin level (or more generally at unit of management level);
- Flood risk management plans (article 7) at the river basin level (or more generally at the unit of management level) focusing primarily on prevention, protection and preparedness; these plans include the setting up of flood forecasts and early warning systems and the promotion of sustainable land use practices;
- updates every six years to take into account the climate change impacts.

2.1. National level

This section aims to give an overview of the current Civil Protection management legislation concerning floods at the national level in Italy and Croatia.

In Italy, the implementation of the Flood Directive in national legislation took place through the enactment of Legislative Decree 49/2010 (*Attuazione della direttiva 2007/60/CE relative alla valutazione e alla gestione dei rischi di alluvione*). According to this decree, District Basin Authorities prepare coordinated flood management plans at the water district level. It is the competence of the regions, in collaboration with the National Department of Civil Protection, the predisposition and the realization of state and regional alert systems for hydraulic risk for the purpose of civil protection.

In the Country, fundamental reference documents concerning flood alerting systems are:

- Direttiva del Presidente del Consiglio dei Ministri del 27/02/2004 *"Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico e idraulico ai fini di protezione civile"* e s.m.i.;
- *Indicazioni operative del Dipartimento di Protezione Civile Nazionale del 10 febbraio 2016 recanti "Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile";*

In Croatia, the reference laws concerning flood risk are:

- Law on Meteorological and Hydrological Activity (NN 66/2019, *Zakon o meteorološkoj i hidrološkoj djelatnosti*)
- Water Act (NN 66/19 *Zakon o vodama*).

It is to remark that flood defence is managed by Croatian Waters (*Hrvatkske Vode*), a government agency founded by the Republic of Croatia and run by the Management Board and General Managers.

A summary of the legislative framework concerning floods in Italy and Croatia is presented in the following table (figure 5).

Italy	Croatia
➢**Legislative Decree 49/ 2010 (Attuazione della direttiva 2007/60/CE relative alla valutazione e alla gestione dei rischi di alluvione)** This decree implements the "Flood Directive" into national legislation. According to this decree: • District Basin Authorities prepare coordinated flood management plans at the water district level; • it is competence of the regions, in collaboration with the National Department of Civil Protection, the predisposition and the realization of state and regional alert systems for hydraulic risk for the purpose of civil protection.	➢**Law on Meteorological and Hydrological Activity (NN 66/2019, Zakon o meteorološkoj i hidrološkoj djelatnosti)** ➢**Water Act (NN 66/19 Zakon o vodama)** are the reference laws concerning flood risk. According to the Water Act, flood defence is managed by Croatian Waters (*Hrvatkske Vode*), a government agency founded by the Republic of Croatia and run by the Management Board and General Managers.

Fig.5: Summary of the legislative framework concerning floods in Italy and Croatia.

2.2. Regional /local level

This section aims to give an overview of the current Civil Protection management legislation concerning floods at regional and local levels in Italy and Croatia, focusing on the partner regions.

All Italian regions have their own laws governing civil protection activities, and they are responsible for the definition of prevision and prevention programmes on the basis of national guidelines. The local authorities (municipalities) are responsible for approving local and inter-municipal emergency plans on the basis of the regional guidelines [2].

Concerning the Italian partners of the project, Molise Region, in coordination with the Department of Civil Protection, has prepared the part of the management plans related to the national, state and regional alert system for hydraulic risk. In 2018, it issued the Regional Council Decree n. 78/2018 regulating the warning system and the regional flood risk intervention model, based on the guidance provided by the National Department of Civil Protection. Relevant in Abruzzo Region is the approval of the Regional Law

34/2002, "Urgent interventions for the prevention of hydrogeological risk in the territory of the Abruzzo Region and highly urgent interventions related to the various risk hypotheses".

In Croatia, according to the official page of the European Committee of the Regions [3], regional authorities (*županije)* are responsible for the organization of activities from their own self-governing areas related to the planning, development, efficient functioning and financing of civil protection systems and for the adoption of an annual plan of civil protection system for the three-year period and develop the system that is adopted every four years. Local authorities (*općine* and *gradovi*) are responsible for adopting civil protection action plans and civil protection exercise plans.

3. Current Civil Protection management legislation concerning forest fires

Forest fires are recurrent phenomena in the EU, and they can impact tremendously human health, the environment, infrastructure and the economy, causing significant damages also due to cascading effects. Because of this, national emergency authorities consider them a substantial disaster risk, even for non-Mediterranean countries. Therefore, the civil protection interest in reducing forest fire risk and in establishing appropriate feedback mechanisms to minimize as much as possible their frequency of occurrence and their impacts is unquestionable. All risk management actions concerning forest fires need to be strictly coordinated and organized, defining clear responsibilities at all levels (national, regional, local) through a solid legal framework.

At the European Union level, it is interesting to remark that the *Forest Strategy 2014-2020* [4] provides a framework for national forestry and forest-related policies promoting the concept of sustainable forest management and identifying the protection of forests from different threats, including fires, as a priority. Moreover, Eurocode 1 (*EN 1991: Actions and structures* [5]) defines protective design measures against fires for buildings made of different materials.

3.1. National level

This section aims to give an overview of the current Civil Protection management legislation concerning forest fires at the national level in Italy and Croatia.

The Framework Law on forest fires in Italy is L.353/2000. It is divided into three parts. The first part develops the themes of forest fire forecasting, prevention and active struggle (i.e. the actions to be taken to extinguish them). The second part deals with the requirements and penalties related to forest fires. In particular, it develops the theme of prohibitions, protections and economic and legal sanctions for those who do not respect the rules. The last part, the third, deals with the financial aspects of the development of the main themes of the forest fire law. In parallel with the rules of the Italian State, the Regions have regulated the subject with regional rules and resolutions.

In Croatia, the reference law concerning forest fire risk is the Law on fire protection (NN 92/10, *Zakon o zaštiti od požara).* Concerning wildfire surveillance, the reference document is Regulations on the protection of forests against fire (NN BR. 26/2003, *Ravilnik o zaštiti šuma od požara – važeci tekst*).

A summary of the legislative framework concerning forest fires in Italy and Croatia is presented in the following table (figure 6).

Italy	Croatia
➢ **Framework Law on forest fires (L.353/2000)** is divided into 3 parts: 1. forest fire forecasting, prevention and active struggle 2. requirements and penalties related to forest fires 3. financial aspects for the development of the main themes of the forest fire law. In parallel with the rules of the state, the regions have regulated the subject with regional rules and resolutions.	➢ **Law on fire protection (NN 92/10, *Zakon o zaštiti od požara*)**. is the reference law concerning forest fire risk . ➢ **Regulations on the protection of forests against fire (NN BR. 26/2003, *Ravilnik o zaštiti šuma od požara – važeci tekst*)** is the reference document concerning wildfire surveillance

Fig.6 : Summary of the legislative framework concerning forest fires in Italy and Croatia.

3.2. Regional/local level

This section aims to give an overview of the current Civil Protection management legislation concerning forest fires at regional and local levels in Italy and Croatia, focusing on the partner regions.

All Italian regions have their own laws governing civil protection activities and they are responsible for the definition of prevision and prevention programmes on the basis of national guidelines. The local authorities (municipalities) are responsible for approving local and inter-municipal emergency plans on the basis of the regional guidelines [6]. Concerning the Italian partners of the project, in Molise, the theme of forest fires is governed by resolutions approving the Regional Plan for Forecasting, Prevention and Active Fighting of Forest Fires (AIB Plan) and by the L.R. 10/2000. The last resolution updating the AIB plan is the Decision of the Regional Government 151/2018 ("*Delibera di Giunta Regionale*"), which approved the 2018/2020 Multi-year Plan of forecasting, prevention and active fight against forest fires, defining the organizational structure of prevention services and active struggle against forest fires. In Abruzzo, the resolutions updating the 2010-2012 Regional Forest Fire Prevention Plan are the Decisions of the Regional Government 447/2013, 518/2014,.617/2015, 381/2017 ("*Delibere di Giunta Regionale*").

In Croatia, according to the official page of the European Committee of the Regions [3], regional authorities (*županije)* are responsible for the organization of activities from their own self-governing areas related to the planning, development, efficient functioning and financing of civil protection systems and for the adoption of an annual plan of civil protection system for the three-year period and develop the system that is adopted every four years. Local authorities (*općine* and *gradovi*) are responsible for adopting civil protection action plans and civil protection exercise plans.

4. Current Civil Protection management legislation concerning seismic risk

Earthquakes are geological phenomena that occur without warning, with consequences that can be highly dramatic. Seismic risk is particularly significant in Southern Europe countries and, in general, at plate boundaries (where more than 90% of earthquakes take place). The civil protection interest in reducing seismic risk and in establishing appropriate feedback mechanisms to minimize as much as possible their frequency of occurrence and their impacts is very strong. All risk management actions concerning earthquakes need, logically, to be strictly coordinated and organized, defining clear responsibilities at all levels (national, regional, local) through a solid legal framework.

The reference document for seismic prevention concerning the vulnerability of buildings in the EU is Eurocode 8 (*EN 1998: "Design of structures for earthquake resistance"* [6]). Its provisions apply, as stated in the same document, to the design and the construction of buildings and civil engineering works in seismic regions, and its purpose is to ensure in the event of earthquakes that human lives are protected, that damage is limited and that structures important for civil protection remain operational. Eurocode 8 is composed of 6 parts dealing with different types of constructions or subjects: o EN1998-1: General rules, seismic actions and rules for buildings o EN1998-2: Bridges o EN1998-3: Assessment and retrofitting of buildings o EN1998-4: Silos, tanks and pipelines o EN1998-5: Foundations, retaining structures and geotechnical aspects, EN1998-6: Towers, masts and chimneys.

4.1. National level

This section aims to give an overview of the current Civil Protection management legislation concerning seismic risk at the national level in Italy.

In Italy, the matter of seismic risk is particularly complex as regards the methods for identifying areas of greatest danger. For what concerns the management of the emergency in case of a seismic event (and not only), the main operating document is the Directive of the President of the Council of Ministers of 3 December 2008, "Operational guidelines for emergency management". The Directive is divided into three parts: the first deals with the issue of event communication (seismic) and the flow of information, and the second part develops the organizational model for emergency management by writing about the network and the relationships between the Emergency Coordination Center (CCS, *Centro Coordinamento dei Soccorsi*), the Mixed Operative Centre (COM, *Centro Operativo Misto*), the Municipality Operative Centre (COC, *Centro Operativo Comunale*) and operating rooms. The third and last part describes the activations of the national and local structures to be done in the event of an earthquake.

For Croatia, no relevant information was reported. It is anyway possible to remark that the Ministry of Construction (*Ministarstvo Graditeljstva*) is the main body when it comes to seismic risk.

A summary of the legislative framework concerning earthquakes in Italy and Croatia is presented in the following table (figure 7).

Italy	Croatia
➢ **Directive of the President of the Council of Ministers of 3 December 2008 "Operational guidelines for emergency management"** is the main operating document for what concerns the management of the emergency in case of seismic event (and not only). It is divided into three parts: 1) event communication and the flow of information, 2) organizational model for emergency management, 3) activation of the national and local structures to be done in the event of an earthquake. Each region has approved operating procedures to manage emergencies, including the case of seismic events.	For Croatia no relevant information was reported, it is anyway possible to remark that Ministry of Construction (*Ministarstvo Graditeljstva*) is the main body when it comes to seismic risk.

Fig.7: Summary of the legislative framework concerning earthquakes in Italy and Croatia.

4.2. Regional/local level

This section aims to give an overview of the current Civil Protection management legislation concerning seismic risk at regional and local levels in Italy and Croatia, focusing on the partner regions.

In Italy, each region within its organization has approved operating procedures to manage emergencies, including the case of seismic events. For Molise, it is reported the approval of the Regional Law 38/2002, "Urgent interventions to face the state of emergency resulting from the seismic events of October 31, 2002 and other provisions of Civil Protection" and of the Regional Law 13/2004, *"Seismic reclassification of the regional territory and new seismic legislation".* For Abruzzo Region, the main reference is the Regional Law 28/2011, "Rules for the reduction of seismic risk and methods of supervision and control of works and constructions in seismic areas":

In Croatia, according to the official page of the European Committee of the Regions [6], regional authorities (*županije)* are responsible for the organization of activities from their own self-governing areas related to the planning, development, efficient functioning and financing of civil protection systems and for the adoption of an annual plan of civil protection system for the three-year period and develop the system that is adopted every four years. Local authorities (*općine* and *gradovi*) are responsible for adopting civil protection action plans and civil protection exercise plans.

Conclusions

In this report, the information collected from the partners engaged in TTF2 of activity 3.1 (Adriatic Ionian Euroregion, Molise Region, Pescara Municipality) and during the working table at the project meeting in Split (24th-25th October, 2019) regarding the current Civil Protection emergency management legislation in Italy and Croatia for the selected target risks (floods, forest fires, seismic) was evaluated and summarised.

This document provides an overview of the main laws and regulations related to each risk area at transnational /national and regional/local levels. Moreover, it wants to be a starting point to pursue the goals of activity 3.3, "*Design of hardware and software specifications of "social media based" Emergency DSS platform*".

References

[1] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (http://data.europa.eu/eli/dir/2007/60/oj)

[2]https://portal.cor.europa.eu/divisionpowers/Pages/Comparer.aspx?pol=Civil%20Protection&c1=Croatia&c2=Italy

[3] https://portal.cor.europa.eu/divisionpowers/Pages/Croatia-Civil-protection.aspx

[4] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A new EU Forest Strategy: for forests and the forest-based sector*, 20/9/2013

[5] EN 1991: "Actions and structures"

[6] EN 1998: "Design of structures for earthquake resistance"

[7] United Nations Office for Disaster Risk Reduction, *Sendai Framework for Disaster Risk Reduction 2015-2030*, 2015 (https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf)

[8] T. Shempp, H. Zhang, A. Schmidt, M. Hong, R. Akerkar, A framework to integrate social media authoritative data for disaster relief detection and distribution optimization, in "International Journal of Disaster Risk Reduction", https://doi.org/10.1016/j.ijdrr.2019.101143, 2019

[9] https://europa.eu/youreurope/citizens/consumers/internet-telecoms/data-protection-online-privacy/index_en.htm

Data sources

www.protezionecivile.it

Floods

www.protezionecivile.molise.it (Molise Region)

www.regione.molise.it (Molise Region)

Forest fires

www.protezionecivile.molise.it (Molise Region)

www.regione.molise.it (Molise Region)

Seismic risk

www.protezionecivile.molise.it (Molise Region)

www.regione.molise.it (Molise Region)

Appendix I – The privacy issue

The upsurge of social media usage in the last decade has opened a new frontier in disaster management, as recognized in the Sendai Framework for Disaster Risk Reduction 2015-2030 [7]. In fact social platforms, whose participatory structure acts as a sort of "collective intelligence", besides being a great source of data, have the potential to be used for bi-directional communication: national, regional and local authorities and the Civil Protection can use them to give to the public, in a prompt and reliable way, important information about the nature and the development of the crisis and the actions being taken for assistance as citizens themselves can act as "social sensors", providing real time data that can help, complementing authoritative data, to detect hazardous events, assess the damages and locate aid seekers (Shempp et al. 2019 [8]).

Naturally, as this is a new interdisciplinary field of study, the difficulties to face in implementing new emergency management systems integrating risk scenarios data from sensory networks and the information voluntarily provided via social media by the public are numerous, inter alia the privacy issue.

The design of a *"social media based" Emergency DSS platform*" needs to take into consideration the General Data Protection Regulation (EU) 2016/679 (GDPR), which is the EU law on data protection and privacy in the European Union (EU) and the European Economic Area (EEA) and applies to both companies and organisations (public and private).

This regulation describes different situations where a company or an organisation is allowed to collect or reuse personal information. When data processing is of vital interests, for example when this might protect human life, there is no need to ask for a specific agreement (known as "consent") [9]. This should be the case of our platform.

For completeness, an extract of article 6 of this regulation is presented:

"Processing shall be lawful only if and to the extent that at least one of the following applies:

a) *the data subject has given consent to the processing of his or her personal data for one or more specific purposes;*

b) processing is necessary for the performance of a contract to which the data subject is party or in order to take steps at the request of the data subject prior to entering into a contract;

c) processing is necessary for compliance with a legal obligation to which the controller is subject;

d) processing is necessary in order to protect the vital interests of the data subject or of another natural person;

e) processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller;

f) processing is necessary for the purposes of the legitimate interests pursued by the controller or by a third party, except where such interests are overridden by the interests or fundamental rights and freedoms of the data subject which require protection of personal data, in particular where the data subject is a child.

[2]*Point (f) of the first subparagraph shall not apply to processing carried out by public authorities in the performance of their tasks."*

Due to the importance of this issue, the General Data Protection Regulation will be further examined in order to assess the possibility of legal problems, not identified yet, that could arise from the use of data collected through specific social media platforms.

Interreg
Italy - Croatia
E-CITIJENS

EUROPEAN UNION

Social media and crowdsourcing: thematic reclassification and consistency analysis report

Report No.3

Summary

1. Introduction 2
2. Analysis of identified hazardous events and risks 3
2.1. Floods 3
2.2. Wildfires 5
2.3. Earthquakes 7
2.4. Risk scenario's elements 8
3. Social networks' information flows 10
4. Quality and location of information 14
4.1. Quality of social media data 14
4.2. Geolocation of social media data 16
5. Semantic ontologies 17
5.1. Semantic interoperability approaches 17
5.2. Sources of semantic heterogeneity in the E-CITIJENS platform 19
5.3. Proposed solution for the E-CITIJENS platform 19
6. Conclusions 24
Bibliography 25

1. Introduction

The work package 3 related to the modelling of "social media based" civil protection emergency management system started with the analysis of risk scenarios, civil protection management legislation and social media and crowdsourcing. The research continues with reclassification and a consistency analysis of these topics. Particularly, for the theme “Social Media and crowdsourcing” the further research, documented in this report, focuses on the following:

- social networks’ information flows related to hazardous events,
- quality and location of information,
- semantic ontologies specific for each risk and criteria for identification of fake information.

The basis for this research is a report on social media and crowdsourcing, which identified types of information shared on social media during disasters. The most suitable and used social platforms were also recognised followed by examples of social media’s use during emergencies by civil protection organisations. However, since the risk scenarios are the basis for information flows and semantic analysis the report starts with analyses the outcome of the Thematic Task Force 1 work and extracts the most important elements of risk scenarios in Italy and Croatia.

This report will serve as a basis for drafting the functional model of "social media based" Civil Protection Emergency system, and later on, for hardware and software design. Finally, the overall research aims at developing a cross border model of an emergency management system, which considers risk scenarios, sensors data, regulatory frameworks, and activation of citizens through social media as emergency active sensor.

This report is prepared by the University of Split, Faculty of Civil Engineering, Architecture and Geodesy.

2. Analysis of identified hazardous events and risks

Hazardous events and risks for Italian and Croatian regions are identified in the report "Analysis of the techniques and metrics used in Italy and Croatia, with a special focus on the partner regions, to model and represent risk scenarios" created in the Activity 3.1 by Thematic Task Force 1 (TTF1): Current risk scenarios. Since the analysis of the social media content posted by citizens decision support platform will create a basis for creation of current risk scenarios this document analyses the outcome of the Thematic Task Force 1 work and extracts the most important elements of risk scenarios which may influence the analysis of social media information flows and semantics.

Three main risk scenarios for both Italian and Croatian regions are identified: floods, wildfires and earthquakes.

2.1. Floods

The elements of the Italian provinces of Molise, Abruzzo and Emilia Romagna for flood risk scenario covers the situation detected and specified by sensors together with alert levels and consequent expected effects. The Italian legislation provides the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality", which indicates the severity of the situation. Flood event scenarios are marked with a colour code, which represents the level of flood severity category (green, yellow, orange, red) and expected effects and damages. To each event scenario/colour corresponds the activation of a precise operational response (yellow-attention, orange-warning, red-alarm).

The main indicator for the evaluation of the hazard is the hydrometric level in the major watercourses. It is assumed in fact that the significance of the possible effects induced by the flood on the surrounding territories can be generally considered proportionally. However, on a regional level the critical situation can be detected only on a local scale and through direct observation.

Molise, Emilia Romagna and Abruzzo regions, as the other Italian Regions, have defined, on the basis of operative indications, the scale of severity for flood risk in function of the hydrometric threshold specifics defined for each regional territory. The emergency severity scales are evaluated daily by the regional Functional Centres. The evaluation is based on data recorded by the monitoring network and weather forecast models.

Levels of hazard are expressed in colours: green, yellow, orange and red. The levels are characterised by the scope of a particular flood: localized, widespread or extensive phenomena in a combination of hydrometric levels and effects on riverbanks, soil or structures. The threshold values referred to hydrometric levels are defined by a region for each instrumented river section and they generally identify the following situations:

- threshold 1: water levels corresponding to the complete occupation of the lean riverbed, significantly below the ground level. It indicates the passage of a not very significant flood, which could however require some hydraulic manoeuvres or preventive actions on the water courses;
- threshold 2: water levels corresponding to the occupation of the floodplain areas or of natural expansion of the watercourse, which involve embankments where present, and may exceed the terrain level. It indicates the passage of a significant flood, with widespread phenomena of erosion and solid transport;
- threshold 3: water levels corresponding to the occupation of the entire river section, close to the maximum recorded or to the bank heights. It indicates the passage of an exceptional flood, with huge and extensive erosion and solid transport phenomena.

Generally speaking, flood risk management in Croatian is performed for each river basin, which includes flood risk evaluation and development of flood risk management plans. Risk scenarios are regularly updated based on new data, particularly before a flooding season. However, there is a difference between north and south Croatia, in fact in the plane floods are very rare in the coastal area, which is more prone to tidal flooding caused by extremely low pressure on the Adriatic Sea and/or strong south winds. Based on EU working document it is presumed that two types of scenarios are being developed: for the most likely adverse event and the event with the worst consequences. The risk type/scenario addressed in the Croatian national risk assessment for floods is the spill of inland water bodies in Danube (while in Italy is fluvial floods).

The National Flood Defence Plan regulates the early warning and the communication system while the Master Flood Defence Implementation Plan defines the four stages of flood defence depending on section specific hydrometric levels (the criteria for their identification is contained in the same document) and the operative actions to be taken in each case. The four stages are:

- state of alert,
- regular flood defence,
- emergency flood defence,
- state of emergency.

Regarding the implementation of the national plan, the Croatian Meteorological and Hydrological Service manages the meteorological and hydrological infrastructure and relevant data and, therefore, it is connected with the 112 centre. The state company "Croatian Waters" defines thresholds and activates warnings and emergency responses. Moreover, in some regions state company "Croatian Electric", which manages infrastructure in the river basins for electric power production, defines thresholds and activates warnings because. On example for Split-Dalmatia County is Cetina river where "Croatian Electric" issues warnings.

2.2. Wildfires

In Italy, forest fire risk scenarios are defined by the regions in regional plans, where each region produces specific danger maps based on specific levels. The basis for the evaluation of forest fire risk is the analysis of vegetation, climatic conditions, humidity, wind, temperature and morphology of the soil.

Molise Region has a plan for the period 2018 – 2020, which defines the scenarios of danger and risk for forest fires in the regional territory. Forest fire risk is defined as the sum of the variables that represent the propensity of plant species to be relatively easily crossed by fire, and the risk prediction algorithm is based on a weighted additive model. The procedure performed is similar to that used in the multi-criteria analysis, in which it is necessary to solve the problem of determining a single evaluation index starting from several factors, both limiting and predisposing. Depending on the season (summer and winter fires), different predisposing factors are considered: in summer, bio-climate, slope, exposure, coverage and use of the land are the parameters are considered, while to calculate the winter risk an altitude is also used.

Pescara Municipality uses hazard scenarios for forest fires defined by the Abruzzo Region. Like in previous case, a weighted additive model is used to calculate the risk and a distinction between summer and winter forest fire events is being made (separate values of risk have been calculated).

Veneto Region uses a fire propagation model to produce dynamic risk maps. In Emilia Romagna, the calculation of the risk for forest fires on a municipal basis is done by combining the values of potential danger attributed considering the use of soil and phytoclimatic regions, with the values obtained from the analysis of the trigger points and with the values deriving from the elaboration of the statistics of the events of each municipality. The parameters used are, among those available, those that best represent the two components of the "risk" value: the probability that the "fire" event will occur, and the severity of the damage that the fire itself can cause. In the case of forest fires, the damage can be described and quantified as the combination of two fundamental components: the quality of what burns and the extent of the fire. From the combination of the data, weighted values are obtained, which lead to the representation of risk in the following classes: negligible, weak, moderate, marked. The scale of the risk values stops at the "marked" degree: in the Emilia-Romagna region no municipality has environmental characteristics and/or statistical data typical of areas having high risk. By applying the methodology described above, it is possible to update the calculation of the risk indices with the data that are detected in relation to the number, extent and distribution of the fires.

As the forest fire management in Croatia, inter-active fire hazard maps are produced by the “Croatian Association for Crisis Management”, a non-governmental association which collects a substantial amount of information. The main sources of data are two state companies “Croatian Meteorological and Hydrological Service”, and “Croatian Forests”, as well as the European Copernicus Emergency Management Service. These hazard maps are used by fire departments in coordination with 112 centres.

Based on EU working document it is presumed that two types of scenarios are supposed to be developed: the most likely adverse event and the event with the worst consequences. The most likely scenario is described as a situation, that usually occurs in summer, where there are forest fires that occasionally threaten people and properties and that can be handled relatively quickly. The worst possible scenario, instead, is described as a situation with extreme weather conditions which favour the development of multiple and simultaneous forest fires of big size in the coastal area of the country. These events usually pose a threat to critical infrastructure and lead to transport congestion, population may need to be evacuated, etc. Each scenario is assessed, showing the difference in the likelihood and specifically in the impact of each possible scenario.

For the monitoring purposes some experimental cameras equipped with fire detection software and numerous human monitoring stations are installed. The cameras are monitored 24/7 from County Crisis headquarters as a part of County fire department headquarters. Fire management support tools are the following: “Adriafire Propagator” which gives live information when fire is detected in a precise area and “Adriafire Risk” being used for smoke detection.

The forest fires’ early warning system obeys the general rules defined by the law. The civil protection units of local and regional self-government units and the Civil Protection Headquarters raise the level of preparedness of the headquarters. The state of alert follows the chain of responsibilities and command of the civil protection mechanism in Croatia. Therefore, when a state of major accident and catastrophe is declared, the civil protection headquarters of the local and regional self-government units and the Civil Protection Headquarters undertake all tasks of harmonizing the operation of the civil protection system operational forces in mitigating and eliminating the consequences.

2.3. Earthquakes

Molise Region has adopted the national law on seismic classification and all the municipalities of the region are classified as seismic ones.

In Emilia Romagna, a true estimate of the seismic risk on a regional scale is not yet possible as vulnerability estimates of urban centres and infrastructural networks at a wide area scale are not yet available. In the region the seismic action, necessary for the design and the implementation of interventions to prevent seismic risk, is defined for each site starting from the seismic hazard parameters provided by the technical standards for buildings. Alternatively, the use of accelerograms is permitted, provided that they are correctly commensurate with the local seismic hazard of the build area considered. During the seismic event, the scenario is obtained through the quick definition of the exposed elements falling within the affected area, which is determined with various techniques as the elaboration of the instrumental measurements of the seismic shaking and its effects on the buildings, fundamental are also the damage communications from the operating structures of the regional civil protection system.

The Municipality of Pescara based its emergency planning concerning earthquakes on the values defined at national level and on the regional studies of seismic microzonation.

The main sensor networks, taken as a reference from the Regional Operational Centres (therefore also from the operational centres of Molise, Abruzzo and Emilia Romagna regions) for the definition of seismic scenarios, are the National Accelerometric Network (RAN, *Rete Accelerometrica Nazionale*) and the Network of the Seismic Observatory of Structures (OSS, *Osservatorio Sismico delle Strutture*), both managed by the Civil Protection Department.

RAN is a monitoring network that records the effects of an earthquake in terms of soil accelerations and it consists of permanent and temporary digital stations equipped with a triaxial accelerometer, a digitizer, a modem/router for transmission of the digitized data via GPRS and a GPS receiver to associate the data with the UTC time as well as coordinates of the station. The data are transmitted to the central server of the headquarters of the Department of Civil Protection, where they are acquired and processed automatically to obtain an estimate of the main parameters that describe the seismic shock.

The national OSS network is made up of 160 publicly owned buildings from municipalities classified mostly in seismic zone 1 and 2. The OSS allows the assessment of the damage caused by an earthquake to the monitored structures; this assessment than can also be extended to similar structures within the affected area, thus providing useful information for the civil protection activity immediately after an earthquake. This monitoring system records the movements of the terrain and of the structures and immediately sends the recorded data to the central OSS server in Rome. The server automatically processes the data and produces a summary report with the maximum values and some descriptive parameters which allow to evaluate the incoming earthquake, the vibrations of the structure and the relative state of damage. Furthermore, in the hours immediately following a severe earthquake, a temporary network consisting of simplified monitoring systems is installed in the epicentre area. In this case, the monitored structures are mainly the buildings designated for the coordination of emergency management interventions.

In Croatia seismological risk maps are managed by the national seismological institute and Ministry of Construction is the main body in Croatia when it comes to seismic hazard. Geophysical Institute & seismological service "Andrija Mohorovičić" as a part of the Faculty of Natural Sciences and Mathematics, University of Zagreb produced seismological hazard maps for the certain return period and Peek Ground Acceleration. "Croatian Association for Crisis Management" combined these hazard maps with characteristics of the area and buildings, infrastructure, population density and some historical data and produced a kind of risk maps.

The Croatian Seismograph Network is operated by the University of Zagreb, in particular by the Department of Geophysics regularly monitors the terrain movements. There are around 30 seismological stations that are being rotated on occasions.

In the case of the catastrophe caused by en earthquake regional civil protection units should obey the general rules set up by the corresponding law. They follow the chain of responsibilities and command of the civil protection mechanism in Croatia.

2.4. Risk scenario's elements

This chapter is dedicated to the definition of the main elements which could be used for creation of scenarios during the analysis of social media posts. Therefore, decision support platform should enable decision maker to use these elements to create ad-hoc risk scenario which corresponds to the situation described by valid social media posts. Considering the situation in both Italian and Croatian civil protection systems, risk scenarios which could be a part of the decision making platform could be composed on the several common concepts. These concepts could be seen as scenarios' building elements, which could be stored in the platform's database and retrieved by the civil protection operator to build a scenario which corresponds to a particular situation coming from social media. This action could help civil protection personnel to visualise the situation through GIS, which will be a part of the platform. Nevertheless, any additional elements relevant and implementable only for either Italian or Croatian side should also be taken into consideration during the implementation in case decision makers find them important for scenarios and situational assessment.

Therefore, this report emphasises the common elements for each hazardous events. For the event of flooding the following concepts are recognised:

- sensors' network being involved in the area under concern of a particular civil protection unit;
- alert levels expressed in colours, meaning that the civil protection, using their experience in similar situation, could associate mostly likely level of the alert for the current situation;
- a range of water levels' thresholds which correspond to a certain level of alert;
- measures to be undertaken in order to cope with the potential dangerous situation.

Moreover, relationships between these concepts/elements might be also established, so the operator could be advised by the system what to choose for other concepts. For example, when choosing a certain level of an alert an operator is simultaneously advised to choose from a set of the most likely measures to be undertaken in a such situation, and vice-versa.

As regards forest fires, the common scenarios' elements could be the following:

- an actual forest fire risk assessment in the concerned region;
- sensors' network (smoke, cameras, human monitoring, etc.);
- probability of fire to occur categorized in adequate classes;
- estimation of fire propagation;
- estimation of damage caused by fire;
- measures to be undertaken in order to cope with the potential dangerous situation.

Same as for floods, the establishment of relationships between the listed concepts/elements for forest fires is fostered.

Although the earthquakes happen suddenly and the early warning or alerting system could be used only for extremely short time before event, the social media posts could be valuable, particularly in the complex and overwhelming aftermath situations. Therefore, the creation of scenarios based on the social media posts could be based on the following elements:

- seismic sensors' network (with actual data);
- seismic hazard maps (return period, acceleration);
- seismic risk maps;
- immediate measures to be undertaken in order to respond to the current situation.
- damage estimation and/or building and infrastructure assessment.

As already mentioned, the establishment of relationships between the abovementioned concepts/elements could help the decision maker in civil protection units to better asses the situation.

3. Social networks' information flows

The report "Social media and crowdsourcing" identified the good practice in exchange of information during the disaster and emergency situations between citizens and first responders. The analysis showed that the use of social media in Italy-Croatia Adriatic regions are in a development phase, being more underused and neglected in Croatian regions than in Italian ones. At the moment, the communication via social media in Italy and Croatia goes only from civil protection organisations towards citizens. However this project has to find a solution how to collect information coming from population, validate it and effectively use it in emergency management process. To this end this chapter provides the basic information flows that should exists and captured in the decision support platform.

Herein, information flow diagrams show how information is communicated using social media from civil protection organizations to citizens and reversely. In this case social media is a mean for transmission of the information.

Herein we use the process or activity model as a basis for description of the information flow. It describes the operations usually performed by the organization aiming at achieving business goals. It describes operational activities, input and output flows between them, as well as input and output flows to/from concepts that are outside the organisation. Herein, the purpose of the process model is to:

- define activities related to the use of social media during disasters and emergencies,
- identify activities that to be implemented in decision support platform,
- provide basis for validation and demonstration of the decision support platform with respect to the project's goals.

For this purpose the BPMN 2.0 notation [1] is used, but limited to the subset which fits the project's purpose (Table 1). Therefore, the activity model is depicted in BPMN notation implemented in Camunda Modeler [2]. The activities will be further elaborated in the Activity 3.3.

The processes follows platform's functionalities and risk scenarios, which are recognised as the most possible situations how citizens will react during the emergency situation and how civil protection personnel will interact with the decision support platform. It is conceptualised as a set of interlinked workflows developed in BPMN 2.0 notation [1]. The activities are derived from the analysis of the use of social media and the envisaged functionalities of the platform.

The figures 1 and 2 show the relationship between information flows within civil protection organisation and citizens and social media being mediator between them.

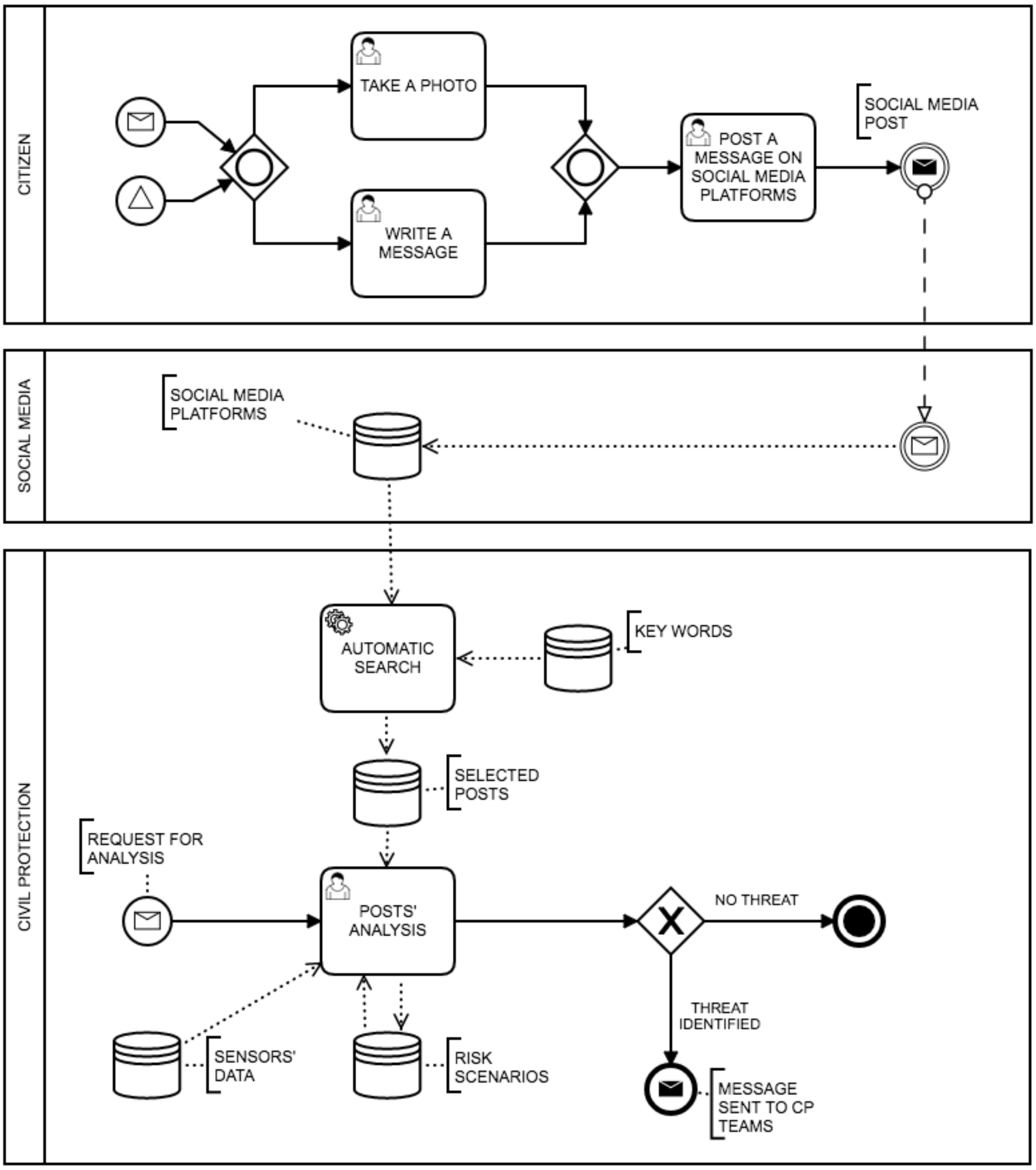


Figure 1: Information flow from citizens to civil protection

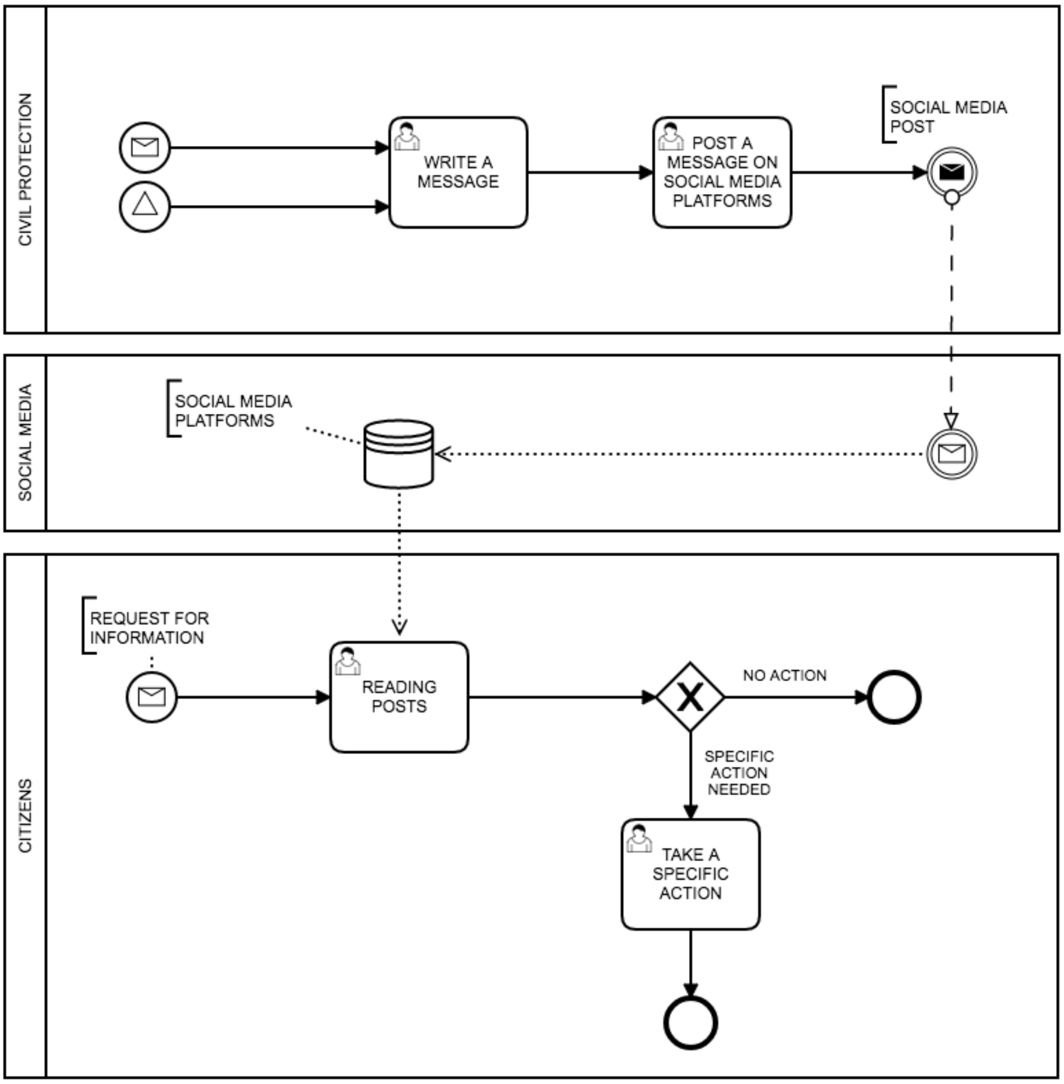
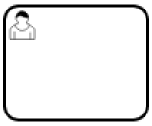
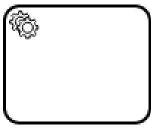
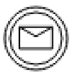
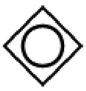
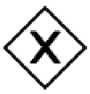
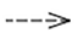
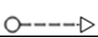


Figure 2: Information flow from civil protection to citizens

Figure 1 shows the crucial process and information flows that have to be implemented in the decision support platform. As already explained, this process does not exist in practice. The process is triggered by a citizen having information about on-going disaster or a sign or an indication new potential emergency. The citizen takes a photo as evidence and/or write a message about it and post it on one or more social media platforms. The decision support platform automatically search for posts at social media platforms in the certain geographic area, a civil protection organisation is in charge for, and selects the adequate ones in accordance with the predefined keywords stored in the platform's database. On the other side of the communication flow, civil protection personnel formally start the analysis of the search results. They also use risk scenarios and sensors data to identify the whether the selected posts are connected to the real threats, which has to be taken seriously and check on-site. Moreover, civil protection personnel can also create new risk scenario, which is relevant for a particular situation connected to the citizens' posts.

Figure 2 shows the process and information flows that go from civil protection personnel to citizens. This process already exists, mostly during the relief phase. The process starts with the information about on-going or recent disaster, or there is and indication of a potential emergency in a near future. The civil protection uses social media to share the information with citizens, who starts their sub-process by having the request for new information and reading posts. After reading the posts, in a case of a threat they act in accordance with the instructions.

Table 1: Legend of used BPMN symbols

Symbol	Meaning
	User task
	Service task
	Data storage
	Signal start event
	Message start event
	Message intermediate throw event
	Message intermediate catch event
	Inclusive gateway (inclusive OR)
	Exclusive gateway (exclusive OR)
	Sequence flow
	Association flow
	Message flow

4. Quality and location of information

Effective emergency operations require complete and timely information but also trustworthy information, the latest issue arises by use of social media and other sources of crowdsourced data such as Open Street Map. The analysis of Twitter made by (Starbird et al. 2010) revealed that the most valuable tweets are the one made by local citizens describing situation on the site. Their importance is in possessing the knowledge of local geography and cultural features which could be unknown to the responders. Also, geolocation of information is crucial for the emergency management because it ensures situational awareness but could also be used in filtering social media data. The key issues describing quality and geolocation of social media data in the context of E-CITIJENS platform development are given in the next subchapters.

4.1. Quality of social media data

Availability of high quality information to decision makers is a critical factor for success of emergency operations (Bharosa et al. 2008). There is more then one definition of data quality. The ISO 9000:2015 defines data quality as the "*degree to which a set of inherent characteristics fulfils requirement*" where requirements are defined as "*the need or expectation that is stated, generally implied or obligatory*". According to (Wikipedia, 2019) "*data is deemed of high quality if it correctly represents the real-world construct to which it refers*".

Data characteristics also named data attributes or data dimensions could be various, up to the specific domain data describes, and often classified in 6 classes: Completeness, Validity, Accuracy, Consistency, Availability and Timeliness (Figure 3); or according to the ISO 25012 to 15 data quality dimensions.

Each data attribute represents an aspect of quality that can be evaluated/measured according to the organization's quality policy. Quality policy is built based on the context and intended use of data throughout the organization. Data quality attributes could be stored in metadata (data describing data) what enables retrieval of quality attributes and data quality assessment.

How to access data quality attributes of social media – a necessary step to use that data in the E-CITIJENS platform?

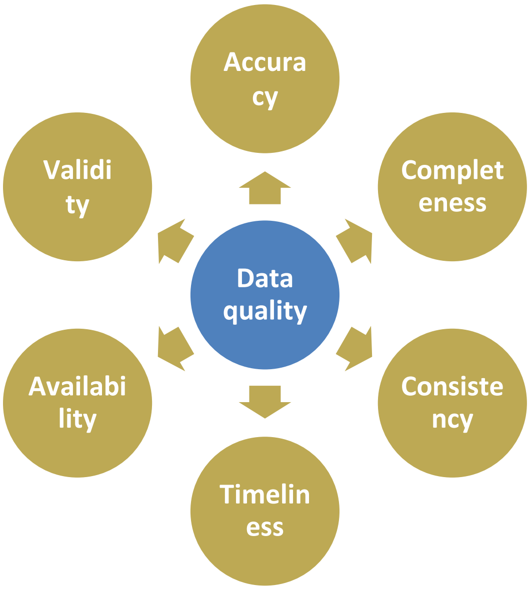


Figure 3: Data quality characteristics

Authors (Ludwig et al., 2015) made a proposal for social media data quality evaluation particularly for decision making in emergency management. Two challenges are addressed:

- How to filter relevant information out of the total amount of citizen generated information?
- How to evaluate the quality of this information?

Two important issues are addressed in their proposal: dynamic quality assessment during emergency operations and subjective/context dependent quality evaluation with regards to the particular user/actor. The main design implications on the future developed platform from the above stated requirements are the following: platform should enable users to select social media sources, geographic area, filter criteria and parameters for quality assessment, all dynamically according to their needs.

After selecting the geographic area, social media source and keywords to filter data (done by user), the platform should present the filtered data and evaluate the quality of data. The authors proposed five data quality attributes to be specified by the user (which could be extracted from existing metadata describing social media) based on which the results will be ranked and presented to the user.

- Link: measured by number of links a post contains (e.g. links to photos or videos or any other external data source), posts with more links are getting higher score;
- Credibility: measured by the number of followers or friends, posts from authors with more followers or friends are getting higher score;
- Up-to-datedness: measured by when the posts were published, more recent posts are getting higher score;

- Dissemination: measured by the number of re-tweets in Twitter or shares in Facebook and Google, posts with more re-tweets or shares are getting higher score;
- Quality of coordinates: measured by the type of source, GPS coordinates are getting the highest score, coordinates derived via names and geocoding services are getting lower score etc.

To conclude, use of social media data for decision making in emergency management could overwhelms the decision makers. Thus, it is necessary to provide tools that will enable users to filter data and does quality assessment accordingly to the particular situation. The proposal above is one of the possible approaches to tackle this complex issue.

4.2. Geolocation of social media data

Geolocation of information coming from social media is the central information for filtering the data. There are few issues that should be clarified so the geolocation could be used properly.

Firstly, the content of the social media data could include the geolocation, showing the geolocation of the event described in the post. Also, geolocation could be of the device from which the post is sent. These two do not necessarily match. Secondly, coordinates could be derived from GPS device, but also via geocoding services by use of city names or addresses find in the posts. The quality of these two sources of coordinates differs.

Geolocation is represented by a geographical point specified by the following:

- latitude (negative number south of equator and positive north of equator);
- longitude (negative values west of Prime Meridian and positive values east of Prime Meridian);
- height (optional);
- coordinate reference system (CRS) (optional).

The first two items represent coordinates defining horizontal position on Earth surface. The third one defines altitude. The CRS gives the identifier of coordinate reference system used. The most used coordinate reference system today is WGS84. Most geographic information systems use European Petroleum Survey Group (EPSG) Registry codes for the CRS identifiers. The EPSG Registry is an open registry including codes of coordinate reference systems, ellipsoids, coordinate transformations and units of measurement along with their definitions in machine readable well-known text (WKT).

5. Semantic ontologies

Semantic ontologies represent one of the approaches for resolving of semantic heterogeneity in process of exchanging information. That is particularly important in disaster and emergency management where information is a basis for decision-making and thus affects the overall success of emergency operations. The next subchapters summarise the existing approaches for the semantic interoperability and propose the solution for the E-CITIEJENS platform.

5.1. Semantic interoperability approaches

Tackling semantic interoperability in the field of emergency response or even broader, in the domain of disaster management, is a challenging task. Participants are specialists from various domains (such as fire brigades, medical aid, civil protection and humanitarian organisations) but also volunteers, affected and unaffected people on site each having its own specific vocabulary. Moreover, in case of cross-border disasters or disasters involving international teams, participants are speaking its own languages. Semantic interoperability should ensure that the exchanged information has got the same meaning to all the participants involved in the information exchange (Sowa, 1999). There are several approaches in resolving semantic heterogeneity in the exchanged information:

- Automatic translation;
- Common terminology;
- Data exchange standards;
- Semantic ontologies.

Automatic translation

Recently developed and advanced tools for automatic translation between languages are very useful but having disadvantages because they do not guarantee correct translation of the meaning and could cause misunderstandings and misinterpretation. Also, semantic heterogeneity exists in the same language between terms of participants having different backgrounds and expertise e.g. term “safe zone” does not have the same meaning to fire brigades and to medical services. Thus, existing automatic translation tools do not satisfy the key requirements of the emergency response and disaster management: accurate and trustworthy information.

Common terminology

Traditional approach is to develop and use a common terminology. Several studies and reports have shown that common pitfalls of that approach, despite all the efforts undertaken either on national or international level, are the following (EPISECC, 2015):

- Developed common vocabularies are still covering only a group of responders and their terms (e.g. UNISD Terminology on Disaster Risk Reduction (UNISDR, 2009) includes only 53 terms);
- Responders are using their own terms, defined in their operational procedures and often incorporated in proprietary software tools;
- Common terminology enforcement by legal act for all the participants is not viable to be achieved, especially to ad-hoc participants: people affected and unaffected on site;
- Terminologies are ever evolving and thus causing that a common terminology should be updated often, what is demanding because the process of introducing a common terminology asks time to be set up, and time to be accepted and put in operation by all.

Data exchange standards

Data exchange standards are necessary to enable data exchange between various communication and information tools used by emergency responders. The most used standards (EPISECC, 2015) are Common Alerting Protocol (CAP) (OASIS, 2010) and Emergency Data Exchange Language (EDXL) (OASIS, 2013). Both standards define syntax, structure and content (list of values or codes) of the messages exchanged between emergency responders. Thus, they introduce their own semantics that have to be accepted by all the participants, not only emergency responders and thus it is not likely to be achieved, especially not feasible for ad-hoc participants.

Semantic ontologies

Recommendations from the Report (Network Centric Operations Industry Consortium, Inc., 2007) include a proposal to use semantic web technologies in extending standards into semantic ontologies and thus enabling computers to process meanings of data. Main characteristics of semantic web technologies are the assumptions of the open world: anytime new information is arriving and there will never be a common agreement so the multiple viewpoints must coexist. Review of semantic ontologies for crisis management presented in (Liu et al, 2013) revealed that there are 11 subject areas and 26 corresponding ontologies. The authors conclude that there is a challenge to achieve the consensus across all the participants and post the question: whether to develop single domain ontology or to specify terminologies covering crucial interoperability gaps.

5.2. Sources of semantic heterogeneity in the E-CITIJENS platform

Considering the proposed aims and functions of the E-CITIJENS platform, the main sources of semantic heterogeneity are in using the terms coming from various domains and from various languages. Summarizing findings from the Reports of activity 3.1, a classification of the main sources of semantic heterogeneity is shown in the Figure 4.

The main classes and subclasses are: Data sources (subclasses: Sensors data (meteorological data, seismic data), Citizens data (social media data, crowdsourced data), Risks (subclasses: Floods, Forest fires, Earthquakes), Operations (subclasses: Early warning, Situational awareness, Relief operations) and Languages (subclasses: Italian, Croatian and English language).

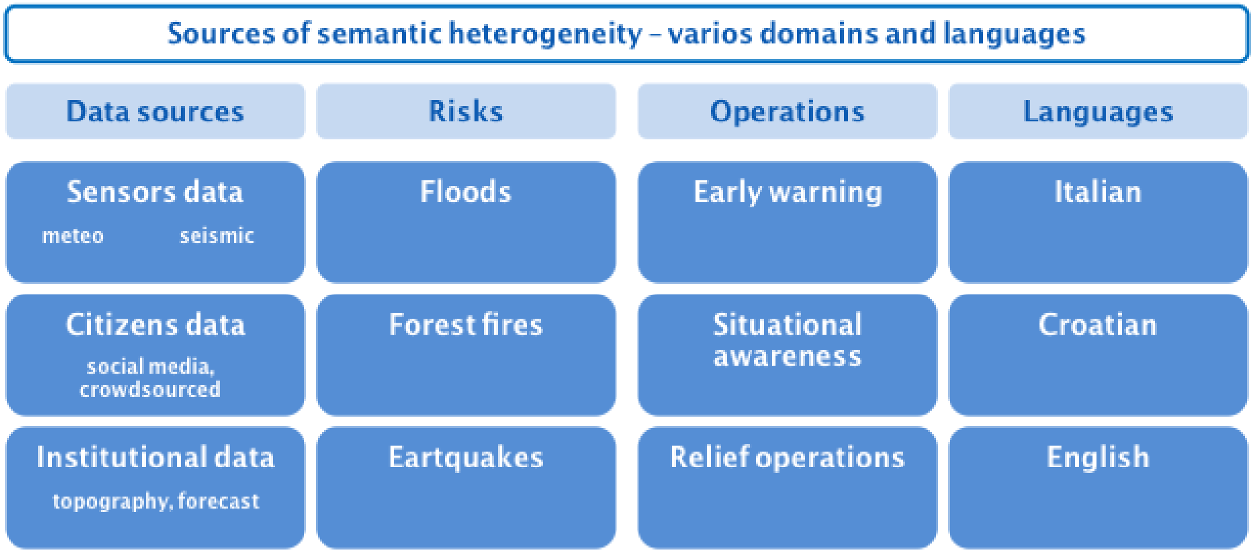


Figure 4: Sources of semantic heterogeneity in the E-CITIJENS platform

5.3. Proposed solution for the E-CITIJENS platform

As there is no single and universal solution for achieving semantic interoperability in the emergency response domain, the proposed solution fits the needs of the E-CITIJENS platform and is viable to be implemented in a variety of technologies, not solely using semantic web technologies. That brings an advantage to the overall design of the E-CITIJENS platform because it allows software developers to use the optimal technology according to all the requirements posted to the E-CITIJENS platform, not posted merely by semantic interoperability.

The approach proposed for the E-CITIJENS platform is a hybrid one, using elements of the approaches summarised in the Chapter 5.1. and considering the sources of semantic heterogeneity in the E-CITIJENS platform identified and described in the Chapter 5.2. The main idea is to specify terminologies covering crucial interoperability gaps and to allow users to continuously upgrade and maintain the terminologies. Therefore, the approach consists of the following steps:

- to develop initial terminology covering key terms in the domains used in the platform;
- to offer that terms in both languages (Italian and Croatian) together with their description in English;
- to store and use developed terminology in the E-CITIJENS platform;
- to enable users to further/continuously develop initial list of terms.

Initial terminology – domains

Initial terminology should cover the domains and languages used in the E-CITIJENS platform. There are the following domains: Sensors' data, Citizens' data, Institutional data, Risk scenarios and Operations. The terminology should be developed using terms in Italian and Croatian languages.

Initial terminology –semantic relations

Semantic relation between terms should be "exact one" what means, for example, that the Croatian term "Požar" has the same meaning as the Italian term "Fuoco". To keep the solution simple and straightforward to be understood by all participants, no other semantic relation is proposed to be introduced in the terminology, such as "narrower" or "broader". Examples of the broader and narrower semantic relations between the terms are: "vehicle" is a broader term of "water cistern", and "water cistern" is a narrower term of "vehicle".

Initial terminology – a structure

Data structures for the terminology's domains are given in the tables 1, 2, 3, 4, 5, 6 and 7.

Table 2: Sensors' data terminology

SENSORS DATA TERMINOLOGY							
No.	Sensor	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept's description (cro)
	Meteorological data						
	Seismic data						

Table 3: Social media' data terminology

SOCIAL MEDIA DATA TERMINOLOGY (key words for search)							
No.	Social media	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept's description (cro)
	Facebook						
	Twitter						
	Instagram						

Table 4: Crowdsourced data terminology

CROWDSOURCED DATA TERMINOLOGY (key words for search)							
No.	Crowdsourced data	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept's description (cro)
	Open street map						

Table 5: Institutional data terminology

INSTITUTIONAL DATA TERMINOLOGY							
No.	Institutional data	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept's description (cro)
	Topographic maps						
	Weather forecast maps						

Table 6: Risk scenarios' terminology

RISKS TERMINOLOGY							
No.	Risk	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept's description (cro)
	Flood						
	Forest fire						
	Earthquake						

Table 7: Operations' terminology

OPERATIONS TERMINOLOGY							
No.	Operation	Term (eng)	Concept's description (eng)	Term (it)	Concept's description (it)	Term (cro)	Concept description (cro)
	Early warning						
	Situational awareness						
	Relief operations						

Identification of fake information

The identification of fake information should be tackled with great attention, particularly during disaster and emergency situation. As it is already elaborated in the report on Social media and crowdsourcing the sources of false information are various and could be connected with various situations. Herein, the solution proposes the human validation of the posts and information automatically selected from social media platforms. The experienced civil protection staff should be able to rapidly recognise malicious, incorrect or opportunistic information which should be dismissed. However the challenge remains with insufficient information when it would be hard to realise the real extent of the threat. Another challenge is so called out-dated information when people post for ex. a random picture of a forest fire grabbed from the internet which does not describe the real threat or situation and could be misleading for the civil protection staff. A specific category is useless information related to a threat or a disaster that is posted in bona fide but clogs the communication in a case of emergency.

6. Conclusions

This report considers the analysis social media and crowdsourcing information collected and reported in the TTF3 report 3.1 and further research including risk scenarios and the following:

- definition of social networks' information flows related to hazardous events,
- analysis of the quality and location of information,
- specification of the main classes for specific risk and criteria for identification of fake information.

The report starts with analysis of the risk scenarios in Italy and Croatia by taking the most important concepts/elements, which will serve to develop information flows and semantic aspect of the decision support platform. The risk analysis defined the common elements for both Italian and Croatian part, which can be used for creation ad-hoc scenarios during analysis of social media posts.

During the analysis of the social media information flows the main processes are defined, which will be implemented in the platform. Regarding geolocation of information coming from social media some crucial aspects related to the source of information and its quality are discussed and emphasised. The geolocation representation is also specified.

Furthermore, based on the work in Activity 3.1 information flows, geo-location information as well as semantic specifications will serve for Emergency Decision Support System software design. This report will, together with other reports from the Activity 3.2, will be the basis for drafting the functional model of "social media based" Civil Protection Emergency system, and later on, for hardware and software design.

Bibliography

1. http://www.bpmn.org (last accessed 10 November 2019)
2. https://camunda.com/download/modeler/ (last accessed 10 November 2019)
3. Bharosa N., Lee J., Janssen M., Challenges and obstacles in sharing and coordinating information during multi-agency disaster response: Propositions from field exercises. *Information Systems Frontiers* 12, 1, 49–65. 2009.
4. EPISECC consortium, D4.1 - Evaluation of the Inventory - Version 2. 2015. Retrieved 2019, from https://episecc.eu/sites/default/files/EPISECC-WP4_D4%201_Deliverable%20Report.pdf
5. Internation Standardisation Organisation, ISO 9000:2015
6. Liu S., Brewster C. and Shaw D., "Ontologies for Crisis Management: A Review of State of the Art in Ontology Design and Usability", Proceedings of the 10th International ISCRAM Conference, T. Comes, F. Fiedrich, S. Fortier, J. Geldermann and L. Yang, (Editors), Germany, 2013.
7. Ludwig, T., Reuter C., Pipel V., Social Haystack: Dynamic Quality Assessment of Citizen-Generated Content during Emergencies, ACM Transactions on Computer-Human Interaction 22(4), 2015.
8. Network Centric Operations Industry Consortium, Inc. Findings and Recommendations for Mobile Emergency Communications Interoperability (MECI). Network Centric Operations Industry Consortium, Inc. Network Centric Operations Industry Consortium, Inc.TM AlNCOIC. 2007.
9. OASIS. OASIS Standard CAP-V1.2. 2010.
10. OASIS. Emergency Data Exchange Language (EDXL). 2013.
11. Sowa, J. F. Knowledge Representation: Logical, Philosophical, and Computational Foundations. Brooks/Cole Publishing Co., 1999.
12. Starbird K., Stamberger J.Tweak the Tweet: Leveraging microblogging proliferation with a prescriptive syntax to support citizen reporting. In *Proc. ISCRAM.* Seattle, USA. 2010.
13. UNISDR. UNISDR Terminology on Disaster Risk Reduction. 2009.
14. Wikipedia, Data quality, https://en.wikipedia.org/wiki/Data_quality.2019.