

Report with the state of the art of local IT and HR single risk management plans

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REPORT WITH THE STATE OF THE ART OF LOCAL HR SINGLE RISK MANAGEMENT PLANS (CROATIA)

1. Introduction

Croatia is located in an area exposed to various natural influences. The effects of these influences can take on larger-scale proportions and result in a number of negative consequences that can lead to accidents and disasters. Precisely due to its geographical location, this primarily refers to impacts of natural disasters such as earthquakes, floods, fires, tidal waves, hurricanes, and storms. Various parts of Croatia due to climatic, relief and hydrological conditions, are exposed to certain natural influences. For instance, the north and east of Croatia are more exposed to floods and earthquakes, while the south is more exposed to tidal waves, hurricanes and storms and fires. However, it is often the case that some of the disasters occur in areas which are not characteristic for that part of Croatia. That is why it is important to work on prevention systems, as well as measures to protect against certain natural disasters, and to find ways to mitigate their consequences.

In this context, the project *Preventing, Managing and Overcoming Natural-Hazards Risks to mitiGATE economic and social impact* – **PMO-GATE** seeks to increase the safety of the project area from natural disasters, as well as disasters caused by human activity. The project also encompasses developing a disaster management system and increasing recovery capacity in order to reduce potential damage. The PMO-GATE project is focused primarily on the local level, i.e. The Kaštel Kambelovac pilot location, which is located in an area exposed to earthquakes, floods, and tidal waves. The system of prevention and defense measures against natural disasters in Croatia is regulated at the local, county and national level, and each lower level has to follow the measures and regulations of the higher one.

The document contains an overview of the existing strategic and planning framework for individual risk management in the Republic of Croatia at three levels. In doing so, particular emphasis was placed on the review of plans at the local level, which includes the Kaštel Kambelovac pilot location. The last chapter consists of examples of good practice in the form of various projects or platforms aimed at managing and/or preventing individual risks.

2. Existing framework of individual risk management

Climate change is an urgent issue at the moment, and is being increasingly globally spread in terms of awareness in recent years. Numerous countries around the world and various world organizations are working towards preventing the risk of climate change and its consequences, as well as the risk of other non-climate impacts and their consequences. The United Nations (UN) takes the issue of the risks caused by climate and non-climate changes seriously. Therefore, in March 2015, at the World Conference on Disaster Risk Reduction in Japan, *the Sendai Framework for Disaster Risk Reduction 2015 – 2030* was adopted. It is an international document that seeks to raise awareness of the risk of natural disasters, reduce human impact on the environment and adapt to climate change. Furthermore, the World Meteorological Organization (WMO) and the UN, through the *South Eastern Europe Disaster Risk Mitigation*, co-financed by the European Commission, identified shortcomings in many South Eastern European countries in terms of disaster risk management, as well as insufficient cooperation between stakeholders to reduce disaster risk, at national and regional levels. As a result of the program, the document *Strengthening Multi-Hazard Early Warning Systems and Risk Assessment in the Western Balkans and Turkey: Assessment of Capacities, Gaps and Needs* was published with the aim of providing a framework for the development of individual disaster risk management plans. It focuses on the capacities of meteorological, hydrological and climate services to support disaster risk reduction and early warning systems in the area of Southeast Europe. At the level of the European Union, numerous legal documents and procedures have been adopted, which seek to monitor the work

of member states with regards to measures of adaptation to climate change and other risks. Considering the fact that the Republic of Croatia is a member of the European Union, in the context of adapting existing Croatian laws and regulations to those of the European Union, it has undertaken the task to prepare periodic reports on measures of adaptation to climate change and other risks at national and local levels. The *National climate change adaption planning and strategies* for 2021 covers adaptation objectives and the institutional framework for adaptation, climate issues projections, ability to adapt, monitoring and evaluation framework, and progress in implementation, including examples of good practice. When reviewing the documents, particular emphasis was placed on those dealing with floods, tidal waves, and earthquakes.

2.1. National level

At the national level in the Republic of Croatia, numerous documents have been adopted describing the risks of natural disasters, prevention and defense measures, and adaptation strategies. In terms of climate change, the first document is the *Strategy for adaptation to climate change in the Republic of Croatia for the period up to 2040 with an overview of 2070* (OG 46/20), which describes anticipated climate changes by the end of 2040 and 2070. The aim of the strategy is to raise awareness of the importance of the effects of human activities on the climate and climate change. Additionally, the concepts and ways of sustainable activities are presented, as well as ways to reduce the impact on the environment and climate change associated with its vulnerability, including floods and tidal waves. In the context of flood protection, the *River Basin Management Plan 2016 – 2021* (OG 66/16) is important since it describes the management of water status and water systems in Croatia, as well as flood risks for transitional and coastal waters. The *River Basin Management Plan 2022 – 2027* is being developed and will be based on the existing Plan (OG 66/16) and the *Preliminary Flood Risk Assessment 2018*, which presents risk elements through preliminary risk analysis and a historical overview of floods for the Adriatic river basin area. In addition, in 2019, *Flood Hazard Maps* and *Flood Risk Maps* were published, on the basis of which further plans on flood risk management are being developed.

Given the fact that Croatia is located in a seismically active area, earthquakes are frequent as an example of non-climate risks. Based on the experience with the earthquakes that occurred in Croatia in March and December of 2020, which resulted in significant material damage and loss of human lives, the document *Earthquake in Croatia from December 2020 Rapid Assessment of Damages and Needs* was issued, which lists the risks of disasters in Croatia, the economic and social effects of earthquakes and the plan for reconstruction and recovery. Risks of (natural) disasters are defined in the *Assessment of vulnerability of the Republic of Croatia to natural and technical and technological disasters and major accidents*, which defines the hazards and risks for the territory of the Republic of Croatia, as well as needs and possibilities for disaster prevention, and serves as a basis for the development of operational plans for the protection and rescue of the population. Furthermore, the Regulation on guidelines for the preparation of risk assessments for disasters and major accidents for the territory of the Republic of Croatia and local and regional self-government units (OG 65/16) prescribes guidelines for risk assessment, holders of risk assessment, and deadlines and data for risk assessment, and the document *Risk assessment of disasters for the Republic of Croatia*, which, in addition to providing an overview and risk assessments of possible scenarios, also analyzes the civil protection system.

Civil protection is a system of organizing participants, operational forces and citizens in order to protect and rescue people, animals, material and cultural assets and the environment in major accidents and disasters, and eliminate the consequences of terrorism and war-related destruction. The civil protection system in the Republic of Croatia is under the Directorate of Civil Protection, which operates within the Ministry of the Interior. Coordination with political, operational and scientific bodies, with the aim of harmonizing knowledge, proposing solutions and adopting appropriate documents in order to reduce the risk of disasters, is performed by the *Croatian Platform for Disaster Risk Reduction*. The framework for the activities and planning of the activities of all participants in disaster protection and rescue in Croatia is prescribed by the *Protection and Rescue Plan in the Republic of Croatia* (OG 96/10).

It is important to note that the *2030 Disaster Risk Management Strategy* is currently under development. As part of the Strategy, an *Action Plan for Disaster Risk Management for the period from 2021 to 2024* was developed as a guideline for its implementation. The Strategy describes compliance with the *2030 National Development Strategy of the Republic of Croatia (OG 13/21)*, sectoral and multisectoral strategies and spatial planning documents in the field of individual risk management, development needs and potentials, strategic objectives and key areas of intervention, as well as an indicative financial plan and framework for monitoring, reporting and evaluating disaster risk management. The *Action Plan for Disaster Risk Management for the period from 2021 to 2024* itself consists of activities that include strengthening disaster risk management, disaster response, and identifies strategic projects in the field of individual risks.

2.2. County level

Each county in the Republic of Croatia has the authority to adopt various documents and acts for its area of jurisdiction. This encompasses management plans, development strategies and the like. Even though Croatia has 20 counties (+ the City of Zagreb), the emphasis is placed on reviewing the management document in the Split-Dalmatia County (SDŽ) as the competent body to which the Town of Kaštela belongs, i.e. the Kaštel Kambelovac pilot location.

The Split-Dalmatia County has adopted the *Marine and Coastal Planning and Management Plan of the Split-Dalmatia County (SDŽ Coastal Plan)* for its administrative area, which includes relief, geological and lithological and climate characteristics of SDŽ's coastal profile, and climate change challenges and adaptation strategies. Also, the *Action Plan of the Split-Dalmatia County in the field of natural disasters for 2021* was adopted, which contains a list of measures and holders of measures in the event of natural disasters. The importance of the holders of measures in the field of protection against natural disasters is prescribed by the *Guidelines for the preparation of risk assessments of major accidents for the Split-Dalmatia County*, which contain risk assessments, possible scenarios and probabilities and analysis of the civil protection system. The *Spatial Plan of the Split-Dalmatia County*, among others, prescribes measures of special protection against

natural disasters, which primarily refer to sheltering people, protection from demolition and natural disasters such as floods and earthquakes.

The Town of Kaštela is part of the Split urban agglomeration area, for which the *Strategy for the Development of the Split Urban Agglomeration Area for the period up to 2020* has been adopted, which describes the urban agglomeration's exposure to climate hazards and weather disasters caused by climate change, and a plan for the development of primary infrastructure. A new development strategy of the Split urban agglomeration area for the next financial period 2021 – 2027 is under construction. The plan for the development of primary infrastructure was also presented by the *Business Development Strategy of Vodovod i kanalizacija d.o.o. Split for the period from 2019 to 2030*, which includes further plans for the upgrade of the wastewater and rainwater drainage system.

2.3. Local level

For areas that are exclusively under their jurisdiction, local self-government units may adopt appropriate action plans, strategies, or provide specific guidelines for the management of a particular aspect of the area. Kaštel Kambelovac as a pilot location is under the jurisdiction of the Town of Kaštela, which has numerous documents at its disposal for the area of individual risk management, which prescribe measures and methods of managing various types of risks.

The *Coastal Zone Management Plan of the Town of Kaštela* offers an overview of water infrastructure and drainage systems, as well as a vulnerability analysis given that the town is exposed to coastal flooding. The Plan also describes policies and management measures related to strengthening resilience to climate change and providing examples for addressing individual measures. When it comes to local plans for managing the risks of natural disasters, the *Action Plan in the field of natural disasters for 2021*, adopted for the Town of Kaštela, is also important, and includes a list of measures and types of activities with regards to individual natural disasters. Along with the plan, the *Risk assessment of major accidents for the Town of Kaštela* was created, which includes analyses and comparisons of the risk of tidal waves, floods and earthquakes in

order to take preventive action to protect the area and population. Also, the *Assessment of the endangerment of the population, material and cultural goods and the environment of the Town of Kaštela* individually represents the types, intensity, effects, and possible consequences of natural disasters. In 2016, for the agglomeration of Kaštela – Trogir, Vodovod i kanalizacija d.o.o. Split, which is in charge of the primary infrastructure system in that area, as part of the Kaštela – Trogir Project, created an *Environmental Protection Study – upgrading the water supply, drainage and wastewater treatment system of the Kaštela – Trogir* agglomeration. The study provides an overview of the current state of the drainage system and hydrological, oceanographic and seismic characteristics of the area of the Town of Kaštela, as well as the impact of climate change on the area of the town.

The civil protection system plays an important role in preventing and protecting the population in the event of natural disasters. For its administrative area, the Town of Kaštela has adopted a *Civil Protection Plan – Mobilization (activation) and increase of operational forces, measures of temporary relocation, care and providing shelter for the citizens, organization and implementation of evacuation*, which prescribes the structure, organization and conduct of civil protection during natural disasters. Also, the *Protection and Rescue Plan – Warning, preparedness, mobilization (activation) and organization of operational forces. Measures for protection and rescue from floods, earthquakes, technical and technological, sanitary, radiological and nuclear hazards* was adopted, which determines the types of risks and threats, specifies procedures and measures for disaster prevention and protection and rescue measures during individual natural disasters.

3. Examples of good practice

Due to the importance of adaptation to climate change and risk management from natural disasters, and in order to facilitate coordination between projects, a platform *Adaptation to Climate Change* was developed under the leadership of the Ministry of Economy and Sustainable Development. Thus, a central place for information and education on adaptation to climate change in Croatia was created. The aim of the platform is to inform the public about climate change, raise awareness of the severity of climate change and the importance of active participation in improving climate events, and encourage all stakeholders to get involved in adaptation planning at the local level.

Another information platform on climate change resilience has been developed for the Adriatic local communities – *AdriaAdapt*, as part of the Interreg Italy – Croatia cross-border cooperation project which bears the same title. The platform includes risk adaptation possibilities, examples of good practice and legal frameworks, and the following documents have been prepared as part of the project:

- *Manual for strengthening the resilience of the Adriatic coast*, which provides an overview of climate change in the Adriatic coastal area, resilience pathways, and prescribed defense measures
- *Guidelines for integrating adaptation into coastal management*, which proposes the establishment of coordination mechanisms, a management vision, shapes the future of adaptation plans and provides ways for the implementation of said plans
- *Guide for mayors*, which describes ways to adapt open spaces to the key challenges of climate change
- *Guide for citizens*, which contains guidelines for the protection of citizens from torrential floods.

There is also an *Interactive Map of Croatia: how safe is your home?* for the entire territory of Croatia, which shows all the relevant information on fires, floods and earthquakes in all towns

and cities. The map was created in order to showcase which towns and cities are safe to live in. For the creation of the map, five-year statistical data were taken from relevant state institutions in charge of monitoring them (Ministry of the Interior, Faculty of Science in Zagreb, Croatian Waters, and the State Administration for Protection and Rescue). The first version of the map was made in 2016, and was updated with new data in July 2020.

In addition to the above examples, various projects in the field of natural disaster risk management have been implemented or are being implemented, and are shown below:




Title: AdriaMORE

Description: Monitoring and managing the risk of coastal weather extremes and floods in support of the Adriatic protection and rescue system

Goal: Improving the existing monitoring and forecasting system in order to support protection and rescue in the Adriatic

Partners: Italy, Croatia

Website: <https://www.italy-croatia.eu/web/adriamore>




Title: ADRISEISMIC

Description: *New approaches for seismic improvement and renovation of Adriatic and Ionian historic urban centres*

Goal: Exchange and systematization of knowledge and practices in solving the issue of seismic reduction

Partners: Italy, Slovenia, Croatia, Serbia, Albania, Greece

Website: <https://adriseismic.adrioninterreg.eu/>



FloodResilienCity

Title: FRC

Description: Flood Resilient City

Goal: Reducing the risk of floods, as well as other types of risks, and organizing a risk management plan for natural disasters

Partners: Germany, Netherlands, Ireland, Great Britain, Belgium, France

Website: <https://keep.eu/projects/7086/improved-integration-of-incr-EN/>



Title: FRISCO1

Description: *Flood Risk Slovenia-Croatia Operations 1*

Goal: Coordination of non-construction measures in order to reduce flood risks and improve flood risk management systems

Partners: Slovenia, Croatia

Website: <https://frisco-project.eu/hr/>




Title: INFRARISK

Description: *Novel Indicators for identifying critical INFRAstructure at RISK from natural hazards*

Goal: Development of a stress-test framework for establishing the resilience of important infrastructure facilities to natural disasters

Partners: Ireland, Switzerland, Spain, Netherlands, Great Britain, Norway, Sweden

Website: <https://www.infrarisk-fp7.eu/>




Title: INTACT

Description: *Impact of extreme weather on critical infrastructure*

Goal: Address the challenges caused by natural disasters, primarily the inability of operations of important infrastructure facilities and lack of energy caused by natural disasters

Partners: Netherlands, Ireland, Finland, Spain, Italy

Website: <https://cordis.europa.eu/project/id/606799/reporting>



Title: Improver

Description: *Improved risk evaluation and implementation of resilience concepts to critical infrastructure*

Goal: Improving risk assessment and implementation of plans for resilience of important infrastructure facilities to natural disasters

Partners: Sweden, Denmark, France, Great Britain, Norway, Portugal, Belgium, Hungary

Website: <https://cordis.europa.eu/project/id/653390>





Title: I-STORMS

Description: *Integrated Sea sTORM Management Strategies*

Goal: Improving transnational cooperation through the exchange of knowledge, data and predictions through common infrastructure, joint strategies for dealing with sea flood emergencies

Partners: Italy, Albania, Slovenia, Greece, Croatia

Website: <https://istorms.adrioninterreg.eu/>




Title: Joint SECAP

Description: *Joint Sustainable Energy and Climate Action Plans*

Goal: Raising the awareness of citizens with regards to risks and appropriate measures related to climate change, development of risk assessment and online platform related to climate change and climate and energy measures

Partners: Italy, Croatia

Website: <https://joint-secap.unicam.it/>




Title: PLACARD interchange

Description: *PLAtform for Climate Adaptation and Risk reDuction*

Goal: Creating a better link between research, policy initiatives and information sources and focusing on research, policies and practices in climate change adaptation and disaster risk reduction

Partners: Portugal, Sweden, Great Britain, Germany, Italy, Switzerland, Netherlands

Website: <https://www.placard-network.eu/>



Title: PRI-MJER

Description: Applied landslide research to develop risk mitigation and prevention measures

Goal: Research and elaboration of the implementation of climate change adaptation measures for mitigation and prevention of landslide risks, along with raising public awareness with regards to climate change

Partners: Croatia

Website: <https://pri-mjer.hr/>



Title: ProteCHt2save

Description: *Risk assessment and sustainable protection of cultural heritage in changing environment*

Goal: Improving the protection, management and capacities for the sustainable use of cultural heritage and increasing its resilience to weather conditions

Partners: Austria, Czech Republic, Hungary, Croatia, Poland, Slovenia, Italy

Website: <https://www.interreg-central.eu/Content.Node/ProteCHt2save.html>



Title: RESIN

Description: *Climate Resilient Cities and Infrastructures*

Goal: Compare and evaluate methods that can be used for climate adaptation planning in order to standardize its adaptation strategy

Partners: Netherlands, Germany, Spain, France, Poland, Slovakia, Great Britain, Austria

Website: <https://resin-cities.eu/home/>



Title: STRENCH

Description: STRENgthening resilience of Cultural Heritage at risk in a changing environment through proactive transnational cooperation

Goal: Addressing the challenges caused by climate change and the risks of natural disasters arising as a consequence in order to preserve the natural and cultural heritage

Partners: Austria, Czech Republic, Croatia, Hungary, Slovenia, Germany, Italy

Website: <https://www.interreg-central.eu/Content.Node/STRENCH.html>



Title: VEPAR

Description: Project for the improvement of non-construction flood risk management measures in the Republic of Croatia

Goal: Prevention of catastrophic flood events

Partners: Croatia

Website:

https://meteo.hr/istrazivanje.php?section=projekti¶m=projekti_u_tijeku&el=VEPAR

REPORT WITH THE STATE OF THE ART OF LOCAL IT SINGLE RISK MANAGEMENT PLANS (ITALY)

1. Introduction

This deliverable aims at presenting the available knowledge regarding the Flood Risk Management Plan for the Italian site, namely the municipality of Ferrara. The documentation is gathered from the authorities in charge for the definition of actions and strategies in case of flood, such as the Civil Protection service or the Region Emilia-Romagna. The structure of the plan is illustrated in the following of this report, as well as the main criteria for deciding the prior actions to take in case of emergency. Briefly, the Flood Risk Management Plan is the set of measures and actions that authorities and population must undertake in case of flood occurrence. It is composed by several steps, starting from prevention measures arriving to post-flood analysis and reconstruction activities.

The Plan is of most importance for Italy, right because it handles with flood-related emergencies. In fact, Italy is a flood-prone country, due to its large and complex watercourses networks and the hydrogeological instability that affects large areas within the country. Some areas are even more instable than others. For example, Ferrara territory, due to its altimetry and natural characteristics, is a critical area for what concerns flood risk. The reader is advised to refer to Deliverable 3.1.1 Part 1, Section 2 for a revision of Ferrara territory characteristics. Consequently, the reader is advice to refer to Deliverable 3.1.1 Part 1, Section 4 and Deliverable 3.1.1 Part 2, Section 2 for a revision of flood hazard and flood risk, respectively. The review of these notions is advisable prior the evaluation of the Flood

Risk Management Plan. Indeed, this Plan is developed right considering the results of flood risk assessment, such as flood risk maps, indexes of exposure etc. In fact, flood risk assessment permits to identify the most critical and vulnerable areas of the territory, where damages are greater, caused, on one hand, by a high flood probability and, on the other hand, by valuable and vulnerable exposed elements.

Flood Risk Management Plan (FRMP) follows the European decree EU Floods Directive 2007/60/EC ^[1], which concerns the definition of flood hazard and flood risk, as well as it identifies the criteria to follow for the redaction of the Plan and the main purposes that must be pursued. Moreover, FRMP follows the Italian execution of the EU Floods Directive, namely the decree D. Lgs. 149/2010 ^[2], which regards the flood events, following European directives and postulating details and method that are specific for the Italian case.

For the sake of precision, it is reported in the following the definitions of flood, flood hazard and flood risk, accordingly to the EU Floods Directive 2007/60/EC:

1. *Flood* is a temporary inundation, involving transport namely mobilisation of high-density sediments, of typically dry areas. It includes inundations caused by lakes, rivers, creeks, eventually artificial drainage networks, every other superficial watercourse also in a temporary regime, natural or artificial, and flooding of low-lying coastal regions due to sea level rise. It excludes flooding not directly caused by meteorological events.
2. *Flood hazard* is the probability of occurrence of a flood event in a determined time interval and in a determined area.
3. *Flood risk* is the combination of the probability of occurrence of a flood event and the potential negative consequences – in terms of health, territory, assets,

environment, cultural heritage and economic and social activities – derived from the event.

2. Flood Risk Management Plan

Directive 2007/60/EC aims at the creation of a communitarian and homogeneous framework for the management of flood hazards, developed on a European scale. The main goal of the EU Floods Directive is reducing negative consequences raised from floods, especially for the safety of human life, cultural heritage, economic activities and infrastructures. Briefly, the Directive aims at the identification and the priority protection of all valuable elements in the territory. Therefore, flood risk maps are outputs of the EU Floods Directive 2007/60/EC that lead to the elaboration of management plans. Specifically, Article 1 quotes:

The purpose of this Directive is to establish 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 activities associated with floods in the Community.

According to the EU Floods Directive 2007/60/EC Article 7, Italy developed its Flood Risk Management Plan (the Italian '*Piano di Gestione Rischio Alluvioni PGRA*', D.Lgs. n. 49, 23/02/2010) ^[1,2], related to the assessment of flood risk maps.

Specifically, Article 7 quotes:

- On the basis of the maps related to Article 6, Member States shall establish flood risk management plans coordinated at the level of river basin district, or unit of management referred to in Article 3 [...].
- Member States shall establish appropriate objectives for the management of floods risks for the areas identified by Article 5 [...], focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity, and, if considered appropriate, on non-structural initiatives and/or the reduction of likelihood of flooding.
- Flood risk management plans shall include measures for achieving the objectives established in accordance with paragraph 2 [...].

Flood risk management plans shall take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of Article 4 of Directive 2000/60/EC, soil and water management, special planning, land use, nature conservation, navigation and port infrastructure.

Flood risk management plans shall address aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking

into account the characteristics of the particular river basin or sub-basin. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain in the case of flood event.

In the interest of solidarity, flood risk management plans established in one Member State shall not include measures which, by their extent and impact, significantly increase flood risk upstream or downstream or other countries in the same river basin or sub-basin, unless these measures have been coordinated and an agreed solution has been found among the Member States concerned in the framework of Article 8.

Member States shall ensure the flood risk management plans are completed and published by 22 December 2015.

Article 7 refers to flood risks maps, that are treated in Deliverable 3.1.1 Part 2. Moreover, it identifies the areas where the plan must be applied: river basin districts, unit of management, portion of an international river basin district lying within the territory and those areas for which the potential significant flood risks exist or might be considered likely to occur.

Moreover, according to Article 7, Flood Risk Management is shared among the State, Regions, Municipalities and citizens. The collective action is demanded to the State and Local authorities, whereas every person must know the risk to which is exposed and how to face it responsibly.

Concluding, according to the Directive, the FRMP is a strategic plan that aims at providing for consultation, with the administrators, stakeholders and citizens in general, of the priority objectives and intervention measures to be implemented in a time-horizon cyclical six-year period based on dedicated programming. It is also expected verification of the implementation status of interventions in terms of efficiency and effectiveness, on the basis of which the Plan is updated progressively depending also on the degree of achievement of objectives and the occurrence of any new contingency.

2.1. Risk management cycle

As mentioned in Article 7(3) of the European Floods Directive 2007/60/EC, the risk management must consider different steps, such as prevention, protection and preparedness. These steps, together with others which face the in and post event actions, compose the risk management cycle ^[3]. All the phases of the flood risk management are illustrated in Figure 1 and they are explained in the following of this section.

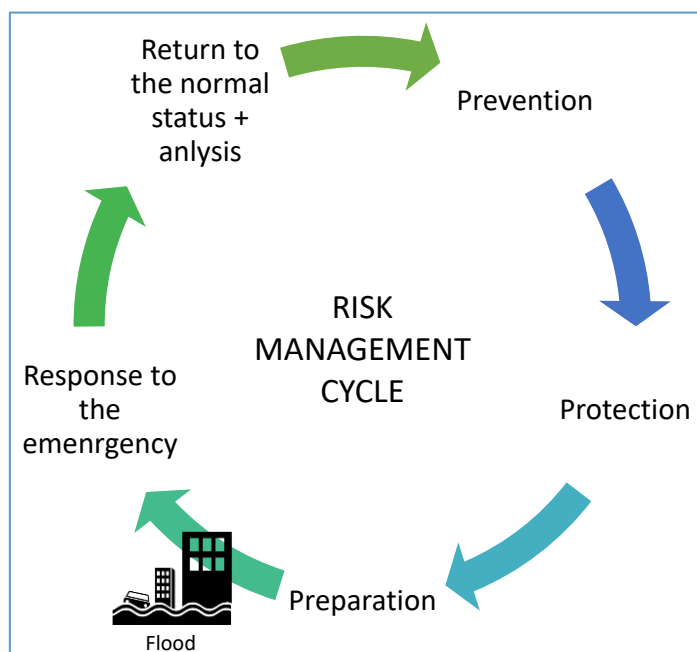


Figure 1. Risk management cycle ^[3].

Risk management cycle can be described within the following five steps.

- *Prevention.* Specific actions proposed by the government, such as proper urbanistic plans, adjustment measures (such as hydraulic invariance, subsidence reduction etc.), the creation of flatlands in the proximity of rivers and watercourses, delocalisation of strategic buildings, monitoring campaigns.
- *Protection.* Reconsideration of the already existing hydraulic infrastructures, such as weirs, walls etc. and project of new ones, such as detention basins. Fluvial resectioning and managing and fluvial requalification interventions. Coastal protections.
- *Preparation.* Alerting and prevision methods. Protocols for protection measures management. Alarm systems. Civil Protection risk management plans. Raising awareness in population.
- *Response to the emergency and return to the normal status.* Backup to the normal status and the before-flood condition. In case of necessity, medical and psychological support are given to people in need. A detailed analysis of the occurred flood event is suggested in order to increase knowledge and competencies and improve the efficiency of following actions (*Prevention-Protection-Preparation*) for future floods.

Prevention

Within the *Prevention* phase of the Flood Risk Management Plan, the specific goals are:

- Limiting the flood hazard applying adequate territorial regulations.

- Modifying and integrating PAI plans ('Piano stralcio per l'Assetto Idrogeologico', that is a document aiming at the regulation and the legislation of the hydraulic risk in the Emilia-Romagna Region territory) for floodable areas not analysed yet and, therefore, individuation and actuation of measures depending on the different territorial realities.
- Modifying and integrating PAI plans in order to improve regulations linking hydrological basin plans and Civil Protection plans.
- The reduction of the flood hazard for residential sites already existing. For example, *Prevention* phase promotes both active and passive protection measurements (such as barriers, moving all private possession in higher floors of the house, imposition of the construction prohibition, as well as prohibition of using basements).
- Mitigation of the expected damage caused by residual risk in the flatland area. This consists in the study of the riversides' strength and the related failure risk, understanding the best interventions for reducing it. Furthermore, this aspect involves also a better understanding of how and when water overflows from riverbed. Therefore, these studies lead to an improved analysis of floodable areas, making possible the improvement of emergencies measures and a better identification of preventive solution for risk reduction.

Protection

The *Protection* phase of the Flood risk management provides for different hydraulic solutions in order to re-establish the normal arrangement of watercourses. For example, it considers interventions such as the widening of riverbank areas, flood plains remodelling, the removal, reduction or softening of weirs or other objects that are source of alteration for the natural hydraulic dynamic in the watercourse. Furthermore, the rebalancing of

sediments in the watercourse and the reconstitution of vegetal life into the river or canal are feasible solutions aiming at flood hazard reduction.

Preparation

The *Preparation* phase can be divided into several actions:

- Provision and installations of alerting systems related to the previous prevision of flood;
- Planning of actions to face the emergency with an institutional regulation;
- Preventive information campaign for the public concerning flood risk.

2.2. The operational guidelines of the Civil Protection Department

The operation guidelines of the Civil Protection Department (namely Flood Risk Management Plan Part B) contains all measured already adopted or to be adopted for the management in “real-time” of the event, proper of Civil Protection services. The contents of the Plan’s Part B are the following:

Forecasting, monitoring, surveillance and alerting implemented through the network of functional centres.

The Region has defined a communication system for different alert levels that starts from the Civil Protection Agency and reaches the Prefectures, Provinces, institutions and structures of the regional civil protection system and the Municipalities, with the identification of the actions that must be carried out following the activation of the various operational phases.

The activation of the civil protection alert phases requires an in-depth analysis of the territory, the use of specialized tools for forecasting and monitoring, as well as specific skills that daily analyse and assess the risk situation.

The alert procedures provide for the activation of three operational phases (attention, early warning, alarm). Each phase corresponds to increasingly narrower territorial areas, more precise information, increasingly incisive safeguard and coordination actions and the progressive direct involvement of citizens at risk.

Hydraulic territorial protection established through adequate regional and provincial structures and subjects.

The activities of hydraulic protection consist in pre-emptive hydraulic monitoring, specific hydraulic control on the territory aimed at supervision, monitoring and verification of the evolution of the ongoing processes. The subjects responsible for the operation of the hydraulic systems and their organization are the Technical Basin Authorities, the Land Reclamation Consortia and the specific Italian authorities called AIPO (Interregional Agency Po River).

Regulation of outflows also implemented through retention plans.

The management plans must contain a list of the large dams present in the basin, the command and control structures and a summary of the studies on the influence of reservoirs and retention plans for the reduction of hydraulic risk.

Support for the activation of urgent emergency plans prepared by the civil protection bodies.

These actions are pursuant to article 67, paragraph 5, of the legislative decree n. 152 of 2006 and the previous legislation.

Correlation between water levels, criticality levels and activated alert phases are established within this content. The objectives are the following: (a) provide Local Authorities with a homogeneous reference framework for the development of Emergency Plans in their territorial area, favouring integration and collaboration with the Territorial Government Offices and the State Bodies on the territory; (b) promote coordinated emergency management, ensuring more effective and timely interventions in the event of floods and other hazards, such as earthquakes, hydro-geological events, forest fires or chemical-industrial risks.

Synthesis of contents of urgent emergency plans prepared by the civil protection bodies.

This issue consists in the identification of the measures envisaged in the planning to achieve the general and specific objectives of emergency management. It is developed by few steps. The first one consists in drafting Provincial Prevention and Prevision Plans, which leads to the elaboration of risks scenarios that show the evolution in time and space of the event and of its consequences on exposed elements. Then it is drafted an Intervention Model at different levels, i.e. regional, provincial and municipal. This model is immediately followed by an alert system. The emergency plan will be effective only if the expected event scenarios are defined as appropriately as possible using all the available knowledge and the related intervention model, in particular through the immediate and coordinated activation of all the necessary resources available on the territory, in a logic of guaranteeing effectiveness throughout the regional territory of public services that relate to the protection of fundamental human rights.

2.3. FRMP – Objectives and measures

The objectives of the Emilia-Romagna Region referable to the Civil Protection area are focused on the use, implementation and improvement of non-structural measures already adopted by the regional civil protection system, focusing above all on the following:

- Forecasting and real-time management of floods by improving the alert system.
- Emergency planning and related verification activities also for the preparation for unexpected events.
- Strengthening of the hydraulic territorial presence with the involvement of municipalities and civil protection volunteering.
- Training of civil protection operators.
- Information to the population on the risk, on prevention and self-protection actions to be adopted and on emergency plans.

As far as concerns the Po River District, the FRMP aims at the following objectives:

- *Improve the knowledge of risk.*

Promote the development of technical and scientific knowledge appropriate to the management of floods and promote the dissemination of basin training for decision makers and citizens adequate to allow the implementation of good defense practices.

- *Improve the performance of existing defensive system.*

Ensure the monitoring, maintenance, integration and adaptation of the existing systems for active and passive defense against floods.

- *Reduce risk exposure.*

Control exposed elements and goods in floodable areas, even for rare scenarios, and promote the reduction of economic vulnerability of the territory and single goods.

- *Assure wider spaces to rivers.*

Envisage where possible the maintenance and/or the reinstatement of floodplains, which are important areas for floods expansion and in the meanwhile for the protection and conservation of ecosystems, accordingly to the EU Floods Directive 2007/60/EC and the Plan for the Po River District.

- *Defense of cities and metropolitan centers.*

Promote sustainable practices for a better land use. Improve the retention capacity of the land and the control expansion of floods in case of extreme event.

2.4. Measures to undertake in case of emergency

The Civil Protection of Emilia-Romagna Region ^[4] designated some recommended behaviours in order to face emergencies in the best way, i.e. self-defence actions in case of adverse climatic conditions. The first recommended action is to check the daily weather forecast, hence paying attention to the alert messages of the Civil Protection, continuously updated in the website of the 'Agenzia Regionale di Protezione Civile' and shared also by media. Other deeply suggested activities that a citizen must undertake during and after a flood event are listed below.

- Drive prudently following signs and indications given by the authority.
- Do not stop along riverbanks and do not start activities in the proximity of the same.

- If the flood threat is dangerous and the specialist authorities advise to leave the house: wear waterproof clothes and shoes, remember life-saving medicines and documents, switch off the gas and electric systems.
- At the end of the emergency, in case of proper flooding, remember that drive in flooded areas can be dangerous.
- Once back in the house, verify the functionality of systems with a specialist.

Figure 2 represents flood hazard for Emilia-Romagna Region. In particular, the image on the left shows an overall flood hazard frame for the entire region, whereas the image on the right shows the detail for the coastal region within Ferrara territory. According to this figure, the coastal area is characterised by a P1 and P3 level of probability of flood event (see Deliverable 3.1.1 Part 1 for the definition of classes of flood hazard). This hazard is mainly related to the force of storm surges, which may produce the propagation of waves toward the inner land, breaking land protection infrastructures, such as sand dunes which are very common in this territory. In fact, the Po River Basin Authority identified the coastal area of the territory of Ferrara as a critical site regarding flood hazard and risk ^[6]. Given the observed hazard for the coastal area of Ferrara municipality, the Italian Flood Risk Management Plan drafted a protocol to follow in order to avoid, or at least diminish, bad consequences and risks ^[5].

- It is not allowed to build new urban centres in P3 area;
- Delocalisation of strategic infrastructure from P3 area;
- Promotion of strategic actions that provide for the backing of seaside resorts from the coastline;
- Maintain adequate free beach areas;
- Conservation, maintenance and recovery of sand dunes systems;

- Actions of passive protection for buildings in P1-P2 areas and strategic adjustment actions for buildings in the P3 area;
- Update of knowledge.

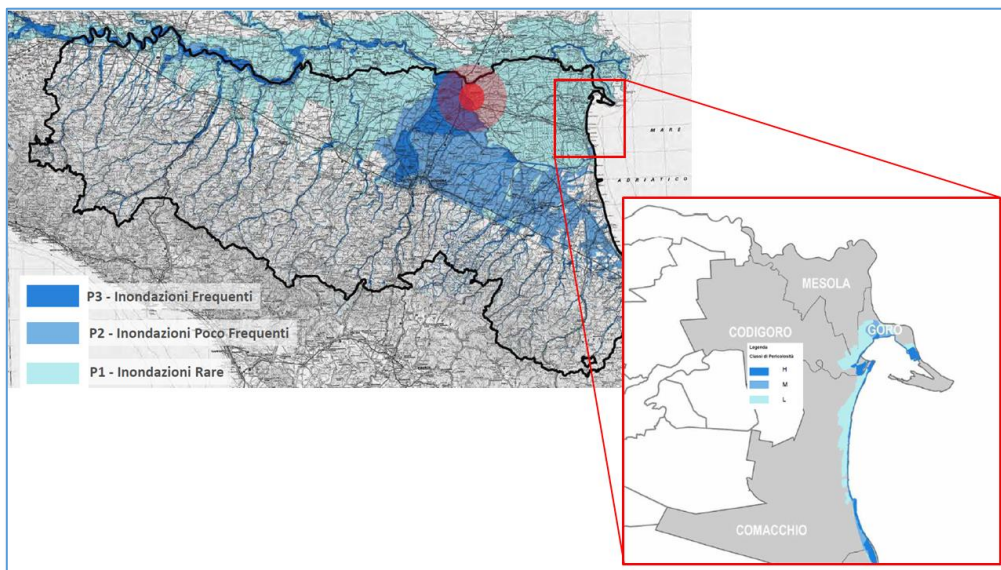


Figure 2. Flood hazard in Emilia Romagna (2015) ^[5] (left), zoom in coastal flood hazard (right).

Data source

[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, Official Journal of the European Union

[2] DECRETO LEGISLATIVO 23 febbraio 2010, n. 49, Attuazione della direttiva 2007/60/EC relativa alla valutazione e alla gestione dei rischi di alluvioni.

[3] La Direttiva Alluvioni 2007/60/EC e le attività in corso nel territorio della Regione Emilia-Romagna, Regione Emilia-Romagna, PGRA

(<http://ambiente.regione.emilia-romagna.it/it/suolo-bacino/sezioni/piano-di-gestione-del-rischio-alluvioni/brochure-info-da-ed2>)

[4] Website Regione Emilia-Romagna – Agenzia per la sicurezza territoriale e la protezione civile (<https://protezionecivile.regione.emilia-romagna.it/>)

[5] M. Guida, M. Mainetti – “Piano di Gestione del Rischio Alluvioni” – Convegno Nazionale Acqua di qualità e sicurezza idraulica – Bologna, 20 marzo 2015

[6] Piano di Gestione del Rischio Alluvioni – Piano per la valutazione e la gestione del rischio di alluvioni, Art. 7 della Direttiva 2007/60/EC e del D.lgs. n. 49 del 23.02.2010 – IV A. Aree a rischio significativo di alluvioni, ARS Distretturali – 2. Schede monografiche, Ambito