Online cartographic database

Final Version 02/08/2025

Deliverable Number D.1.2.1.

Project Acronym	Digital Plan
Project ID Number	ITHR0200430
Project Title	Civil Protection Plan Digitalization through Internet of Things Decision Support System based Platform
Specific objective	2.1
Specific objective Title	Promoting climate change adaptation and disaster risk prevention, resilience, taking into account eco-system based approaches.
Work Package Number	1
Work Package Title	Digitalization model of civil protection plans and IoT EDSS Platform Development
Activity Number	1.2
Activity Title	Development of an Online cartographic database
Partner in Charge	LP - GAL Molise
Partners involved	All partners
Status	Final
Status	Public

Index

About Digital Plan Project

The main objective of the project is the digitalization of civil protection plans, already operatives in the territorial areas of competence of the PPs, to improve the capacity of local authorities to investigate the risks present, to define common operational methods of action in the event of a disaster and in particular to share all the emergency planning with other bodies and agencies in charge of rescue, for compress intervention times, and with the population.

Project relevance

The selected theme of digitalization of CP Plans represents a common interest for Italian and Croatian territories that present similar problems and demand common transnational solutions. Fragmentation of the area and different status of civil protection systems create heterogeneity in hazard handling. Yet, risks and disasters, sure enough, do not recognize state borders and other boundaries imposed by human conventions and treaties. Common risks affect the whole area and the need for a homogeneous, interoperable, and EU-integrated approach is a necessity. This means both homogenizing plans and procedures in the area and presenting common tools for civil protection plan digitalization.

Further to homogenization, such a plan, its accompanying capacity building and training, and its adoption by partners will strengthen the administrative and technical capacities of local

authorities in managing hazardous and emergencies. Moreover, partners will benefit from the transnational process of exchange of know-how and from a common basis of knowledge and experience, which will help individual solutions for enhancing resilience in uniformly dealing with natural and man-made hazards within the involved territories. By empowering territorial resilience, the project reduces overall Italian and Croatian programme area vulnerability through extensive information interchange in both vertical and horizontal directions.

The Digital Plan project will contribute to disaster risk reduction, and management efficiency both in the planning phase and in emergencies, collaborating in the building of resilience in the Adriatic region, through the strengthening of cross-border territorial cooperation with the help of innovative technologies both through DSS (Decision Support System) and through the integration of IoT (Internet of Things) sensors.

A poor sharing of emergency planning and management tools and the effects of forecast and ongoing climate change such as extreme weather events, floods, droughts, increased temperatures, and major snow events are a "powder keg" in the world of risk management and the emergency.

The cooperation between the territories of Italy and Croatia, with this project, supports the strengthening of resilience in all sectors of activity in the field of civil protection; then the focus risks of the project, chosen by the PPs, identify innovative technological tools and to support decisions, also with climate adaptation actions.

The territories of the PPs, given the short distances, also share the impacts of multiple extreme phenomena with meteorological or seismic forcing, for which it is essential to share knowledge, skills, and equipment in the event of disaster response, but also during the other phases of the resilience-building and contingency planning cycle.

Until now, the world of extreme events and climate change has been seen as two separate entities, but this is not correct. The main challenge derives from the assumption that good emergency response planning also makes it possible to identify and apply tools and climate adaptation actions.

This cross-border initiative is particularly needed while the entire Adriatic region is preparing to manage events related to climate change and the management of any emergency crises. Climate change mitigation and adaptation can only be achieved through an integrated approach of territorial cooperation and resilience building by endorsing the entire resilience cycle: planning and preparedness, prevention, response, mitigation, recovery, and adaptation towards a new equilibrium. The Deming cycle, the reference point of emergency planning (planning, execution, control, and adjustment), can be perfectly integrated into this cycle.

Finally, in the Sendai Framework for Disaster Risk Reduction (2015-2030), the project's actions support the ultimate goal of achieving results.

The 2015 Sendai Document and the United Nations International Strategy for Disaster Reduction emphasized the need to address disaster risk reduction and climate change adaptation in setting sustainable development goals.

The project with its actions goes precisely in this direction and specifically aims to improve the understanding of disaster risk, improve disaster preparedness for effective response and rebuild better in the recovery phase by setting some overall objectives in the project actions such as increasing entities with their disaster risk reduction strategies and increasing the availability of and access to multi-hazard early warning systems and disaster risk information and assessments.

WP1: Digitalization model of civil protection plans and IoT EDSS Platform Development

WP1 aims to develop a cross border model for civil protection plan digitalization. It will be based on a set of activities, starting from collection of data from civil protection plans, selecting the risks affecting the plans, the emergency flow charts, open data sources like public and private platforms, websites and webcams, to carry out at preliminary analysis of the needs of each individual PPs and to study the local civil protection plans. Furthermore, WP1 also focuses on the development of a scalable and capitalizable IT platform that can achieve several goals: (i) digitization of civil protection plans; (ii) access to geolocated open data sources and IoT sensors; (iii) manage synthetic georeferenced environmental data. Given the ongoing impact of climate change and its potential to increase the frequency and severity of extreme weather events, a key component of the platform will involve conducting multivariate statistical analyses.

Activity 1.2.: Development of an Online cartographic database

Starting: Period 1, month 1-6, 01/03/2024 – 31/08/2024

Ending: Period 2, month 7-12, 01/09/2024 - 28/02/2025

LP1 in collaboration with PP4 and PP7 will create a template to collect local territorial geolocalized data and identify Emergency Points of Interest (E-PoI), such as emergency operational centers, dangerous areas, emergency areas, helicopter landing areas, and others. The PPs will be provided with the template to fill in the requested data in vector or raster format.

LP1, PP2, PP3, PP5, PP6, and PP8 will complete the template with the required data in the specified format. LP1, with support of external providers, will develop the online cartographic database. The developed database will be structured according to thematic sections, describing the territory, risks, and emergency management put in place. The database will be connected to the EDSS platform through standard interdata connectors (API) and used by the platform as the primary source of information. LP1 will be responsible for developing the database software.

Description of the online cartographic database

Online cartographic database that will include thematic sections, describing the territory, risks, E-PoI and emergency management put in place inside the areas covered by civil protection plans.

Cartographic data

Cartographic data is information related to a specific geographical zone. Data storage involves two aspects, persistence of master information and linkage to a specific geographic area.
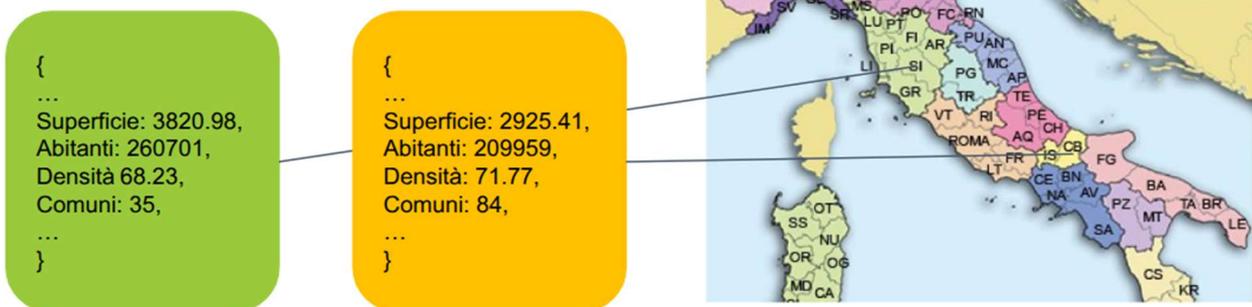
When talking about cartographic data, the most significant distinction that needs to be made concerns the type of data. There are two main types: vector data and raster data. Vector formats are used to describe (i.e. add information to) a specific geometry such as a polygon, a line or a point. Because vector data have vertices and paths, this means that the graphical output is generally more aesthetically pleasing. Furthermore, it gives higher geographic accuracy because data isn't dependent on grid size. The raster format, on the other hand, consists of a matrix of cells (or pixels) organized into rows and columns (or grid) where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, images from satellites, digital images. When deciding between raster vs vector models, one of the primary things to consider is whether the data you are representing is continuous or discrete. In general, discrete data is best handled by vector models, while continuous data is best left to raster models. Discrete features are typically nouns. There are

definite changes in characteristics between them, and they have exact boundaries. Examples of discrete objects would be a pond, building, or county. Continuous data, on the other hand, is more fluid. Continuous data is often a measure of concentration level, and there aren't sharp changes between values. Instead, it smoothly transitions from one value to the next. For instance, temperature, soil pH, elevation, CO_2 levels, and air pressure would all be continuous data types.

Since each raster cell represents just one value or attribute, it's much easier (and faster) to do mathematical calculations and modeling with raster data. Plus, while vector models tend to do a poor job storing and displaying continuous data, the grid surface of a raster model is well suited for doing so. When it comes to displaying linear paths and feature boundaries, vector models are by far the better choice. To start, the graphical output tends to be much more aesthetically pleasing, especially considering that raster models can end up looking rather pixelated when scaled. In contrast, vector points, lines, and polygons can be scaled up or down without sacrificing quality. Plus, if you have multiple data fields and attributes to store, vector models will once again be the better choice, as vector data points can have as many attributes as you choose.

The data related to the project are all vector types since they all aim to associate information with a geographically referenced point, line or polygon.

Vector data will need to be recorded on a database, this implies using a shared standard for defining common tables (same columns with same names).

Data structure

The structure of the database, based on the applications provided by the web platform, needs standardization of data from the various partners both to be able to apply common

filters and for consistent visualization on a map. This involves defining common patterns, i.e., fields, both for the area of interest and for each risk and related resources.

Field 1	Field 2	Field 3	Field 4	Field 5	Partner	Geometry
…	…	…	…	…	LP 1	…
…	…	…	…	…	LP 2	…
…	…	…	…	…	LP 1	…
…	…	…	…	…	…	…

The analysis carried out in D.1.4.1 reveals the common data structures of risks and dictionaries to be stored in the database.

Database

The PostgreSQL DBMS with the PostGIS extension was chosen to implement the cartographic database.

PostgreSQL, also known as Postgres, is a free, open-source object-relational database system (ORDBMS). Postgres's key features are reliability, data integrity, functionality, and extensibility, along with its own open-source community that manages, updates, and develops high-performance and innovative solutions. For querying and interacting with data, Postgres uses a subset of SQL.

PostGIS extends the capabilities of the PostgreSQL relational database by adding support for storing, indexing, and querying geospatial data.

The information is structured and organized as in a relational database, the PostGIS extension allows, where necessary, the addition of columns with cartographic information to the relational data stored in the Postgres database.

API

In order for the various platform services to interact with the database using web protocols and make it an online database, a service that exposes APIs is needed.

APIs, or application programming interfaces, are sets of definitions and protocols used to build and integrate application software. They are sometimes defined as a contract between an information provider and the user receiving that data: the API establishes the content requested by the consumer (the call) and the content requested by the producer (the response). In essence, if you want to interact with a computer or system to retrieve information or perform a function, an API helps communicate the request to the system so that it can be understood and fulfilled.

The four basic operations for managing information in the cartographic database are the so-called CRUD: Create, Read, Update, and Delete. The APIs will then have to allow crud operations on all database tables, managing the relationships between the data. The APIs are implemented in the REST style.

Representational state transfer (REST) is an architectural style for distributed systems. The term REST refers to a data transmission system over HTTP without additional layers. REST systems do not include the concept of sessions, meaning they are stateless. The REST architecture is based on HTTP. Its operation involves a well-defined URL structure that uniquely identifies a resource or set of resources, and the use of specific HTTP methods for

retrieving information (GET), modifying it (POST, PUT, PATCH, DELETE), and for other purposes (OPTIONS, etc.).

Architecture

Through the API access layer, platform applications and authorized external systems can perform CRUD operations on the cartographic database via REST calls over the web.