



ARCH D4.4

Knowledge Information Management System for Decision Support

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Executive Summary

This deliverable has been prepared for the European Commission-funded research project ARCH: Advancing Resilience of historic areas against Climate-related and other Hazards. It is the key output of task 4.4 “*Knowledge Information Management System for Decision Support*” within Work Package (WP) 4 “*Hazard & Object Information Management System*”.

This deliverable reports on the development of the ARCH Knowledge Information Management System, with the aim of passing integrated data and information (from tasks 4.1, 4.2, and 4.3) to WP5 (tasks 5.1 and 5.2) and WP6 (tasks 6.1 and 6.2) and for integration into the ARCH disaster risk management system in WP7 (tasks 7.6 and 7.7).

The large amount of data needed for assessing and managing disaster resilience in historic areas, and the multiple interconnections between tangible and intangibles entities and services provided by historic areas, brought the ARCH project to face and overcome the complexity of defining a conceptual data model aggregating data retrieved by distinct databases to generate meaningful information and of processing information to generate knowledge.

This deliverable summarizes methods, data and results obtained by the ARCH project to generate relevant information and knowledge to support decision making process related to the resilience of historic areas to climate change and other hazards.

In particular the deliverable reports on:

- The established interoperability between the ARCH Information System and the ARCH Decision Support System (DSS) for the exchange of information
- The great potentialities in terms of knowledge management and knowledge generation that might arise from:
 - the implementation of ontology-based and semantic-based spatiotemporal assessment towards enhancing the awareness and the capacity building on disaster resilience at historic area-level;
 - automated approaches for 3D modelling and the automatic crack/damage detection based on deep learning towards the preventive conservation of cultural heritage buildings.

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List of Abbreviations

Abbreviation	Meaning
ACM	Association for Computing Machinery
AI	Artificial Intelligence
CH	Cultural Heritage
CREAM	CREativity Machine
DFO	Dynamic Flood Ontology
DIKW	Data-Information-Knowledge-Wisdom
DSS	Decision Support System
GIS	Geographic Information System
HA	Historic Area
HARIS	Historic Area Information Management System
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
KM	Knowledge Management
POI	Point of Interest
RAD	Resilience Assessment Dashboard
RMI	Resilience Measures Inventory
RPVT	Resilience Pathway Visualization Tool
SOSA	Ontology Sensor, Observation, Sampler, and Actuator
SSN	Semantic Sensor Network
TERMINUS	TERritorial Management and INfrastructures ontology for institutional and industrial USage
THIS	Threats and Hazard Information Management System
VUM	Vulnerability Upper Model
WP	Work Package
WS	Web Service
XML	Extensible Markup Language

Annex B. ARCH tools for visualizing and accessing information

To make relevant *Data* and *Information* accessible to the pilot cities and other users interested to browse *Data* and *Information* of their historic area, specific web-tools were designed by partner INGV. In particular, as already described previous deliverables (i.e. [8][9]), three tools have been developed, namely:

- **GIS Dashboards** enable users to obtain information by location-based analytics, using intuitive and interactive data and maps to be viewed on a single screen.
- **Building/Object Sheets** to query and visualise structured data included in the databases, for example providing information about assets and objects in the historic areas; these web-sheets will be used also for editing and data entry performed by authorised users.
- **3D model viewer** to visualise the three-dimensional models of assets and objects, also enabling users to extract a subset of three-dimensional data.

The web tools are integrated into the same web-platform to show the data and information included in both HARIS and THIS; specific GIS dashboards have been developed whose details can be found in D4.1[10].

This document illustrates the way to recover metadata and link to the data\services by means of the Geocatalog, that is a tool integrated in the same web-platform.

In this section, the Geocatalog (version v1.2021) is presented and a quick user manual is illustrated. Currently, the landing page of the information systems can be reached (Figure 22) at the web link <http://www.cs.ingv.it/ARCHPortal/>.

The access way to the web-platform, as reported in this document, is the same as that already described in D4.2 [8] and D4.3 [9].

After clicking on the button at the top right in the landing page, the user can login (Figure 23), if registered, otherwise they can request the registration of a new account (Figure 24), that will be managed by INGV before granting it. This control process is necessary as the authorised user has access to all functionalities; with the possibility also of modifying information concerning the assets of their own historic area. However, the unregistered user can have access in consultation mode to all public information contained in the systems.

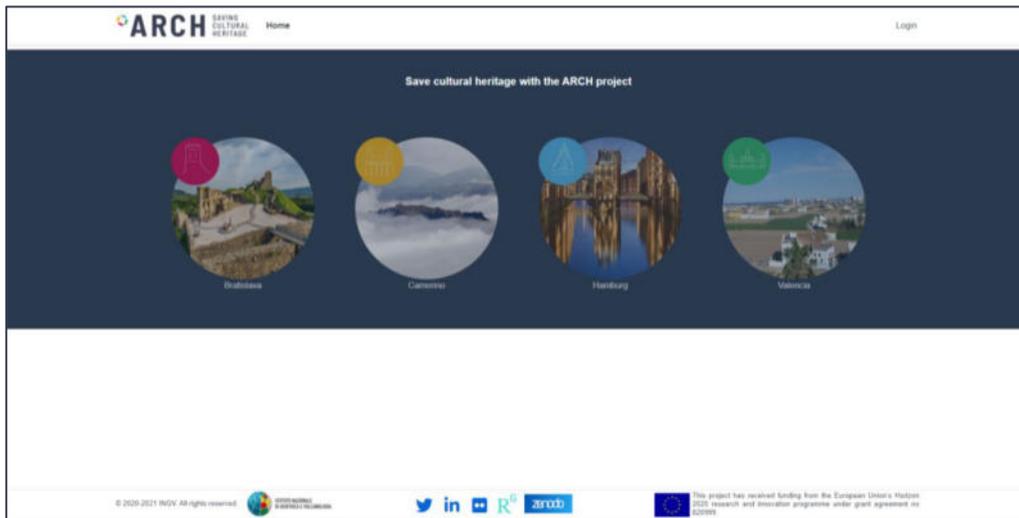


Figure 22. Landing page of the Information System platform

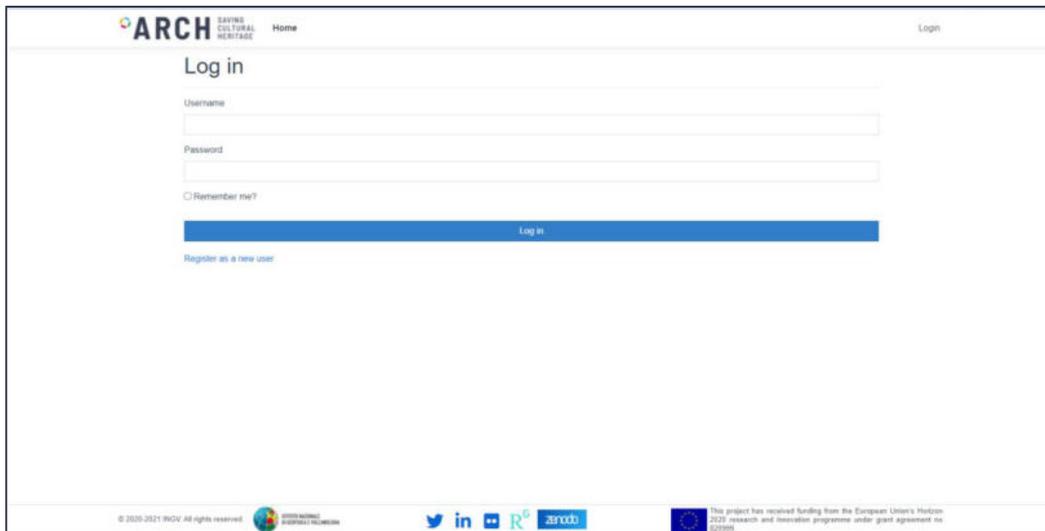


Figure 23. Login to the information systems



Figure 24. Registration of new account

On the landing page, the image of the city lights up when the mouse pointer is positioned over it and, at this point, the corresponding GIS dashboard (Figure 25) is loaded with a simple click. Once this new page has been loaded, a menu in the header (orange frame in Figure 8) allows accessing to the tools of the information platform, always remaining available so that the user can easily change their choice. This menu reports the follow link:

- “Home” to return to the landing page and choose another city;
- “GIS dashboard” to obtain the tool to query the cartographic layers both in HARIS (cf. Section 4.2 in D4.2 [8]) and THIS (cf. Section 7 in D4.3 [9]);
- “Construction\Object Sheet” to consult the information on the assets (cf. section 4.3 in D4.2 [8]);
- “Geocatalog” to browse and search metadata and link related to GIS web-services and datasets in HARIS and THIS.

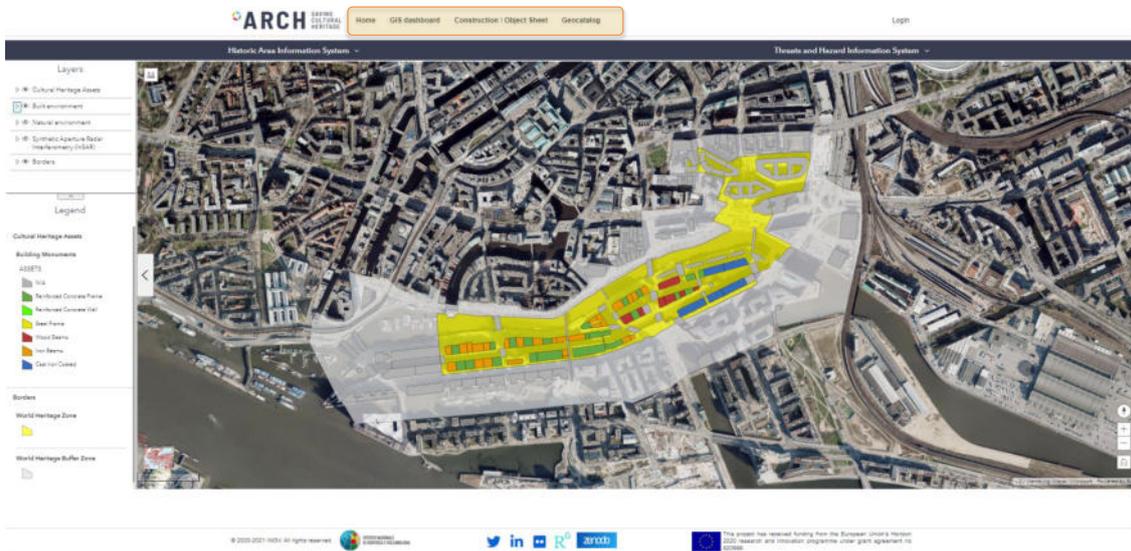


Figure 25. Example of web page of the platform relating to the information system. From this page it is possible to reach the Geocatalogue by clicking the link in the header menu (orange frame).

Geocatalog

By clicking on "Geocatalog" in the header menu (Figure 25) , three tools become available:

- **“Search in the Catalog”** (Figure 26), that allows performing a query related to the name and keywords to filter available datasets\service. Moreover, on the left of the page different other filters can be set to skim potential datasets of interest. A submenu for each dataset\service allows obtaining:
 - the metadata in different formats, by clicking on “HTML”, “XML”, “JSON”, respectively;
 - the “Links” to the resource, if available;
 - the “Preview” of the dataset\service (cf. map pane in .)
 - the download of the dataset (or the HTTP web-page relating the service) by “Download (HTTP)”
 - the information reported on the map by “Add to map”, which can be explored in detail as well as it is possible through the link below.

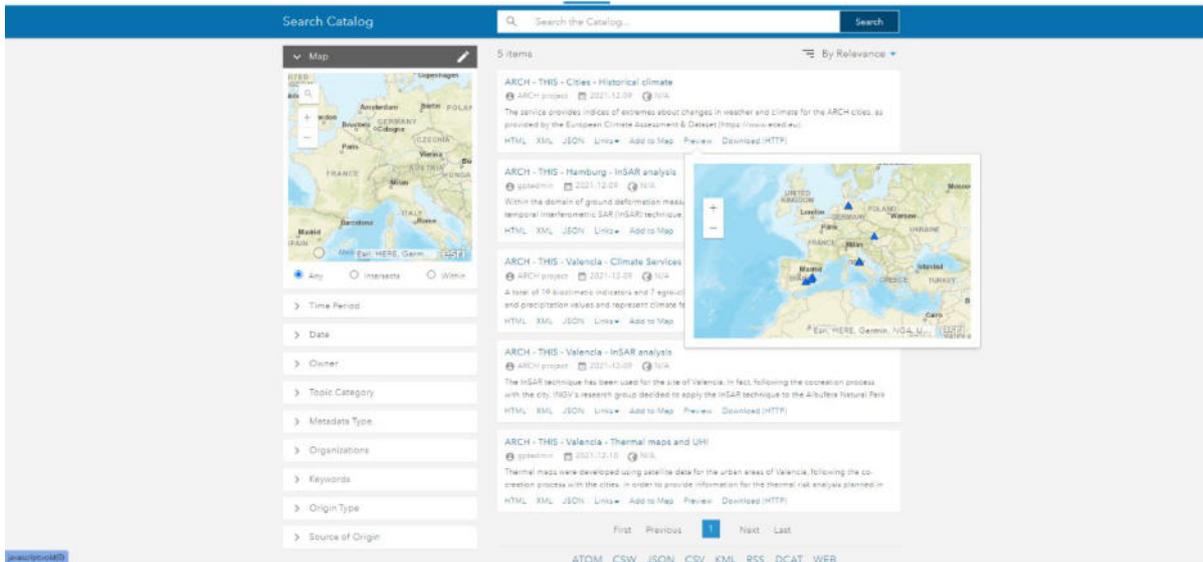


Figure 26. “Search in Catalog” web-page

- **“Explore on Map”** (Figure 27) allows exploring one or more datasets and/or services, which can be added by search button  and activated/deactivated by layer button . Legend of the active layers can be viewed by the legend button . Fields and values included in the dataset/service can be obtained in table by clicking on the arrow in the bottom centre of the map. The other buttons in the upper-left also permit to manage the zoom or to find a specific place on the map.

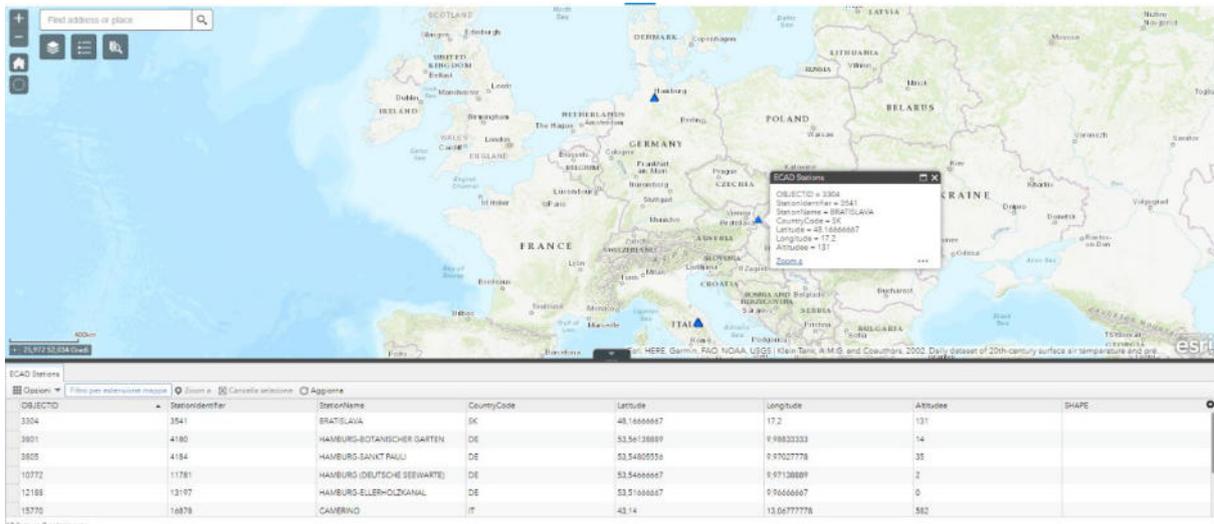


Figure 27. “Explore on Map” web-page

- **“Browse 3D Models”** allows to directly open a 3D object stored in the ARCH repository by clicking the button  on the related row of the list (Figure 28.a), thus the web-viewer application opens for a realistic view of the asset (as point cloud or mesh) in the three-dimensional space (Figure 28.b) - cf. Section 4.4 in D4.2 [8] for details on the 3D viewer tool.

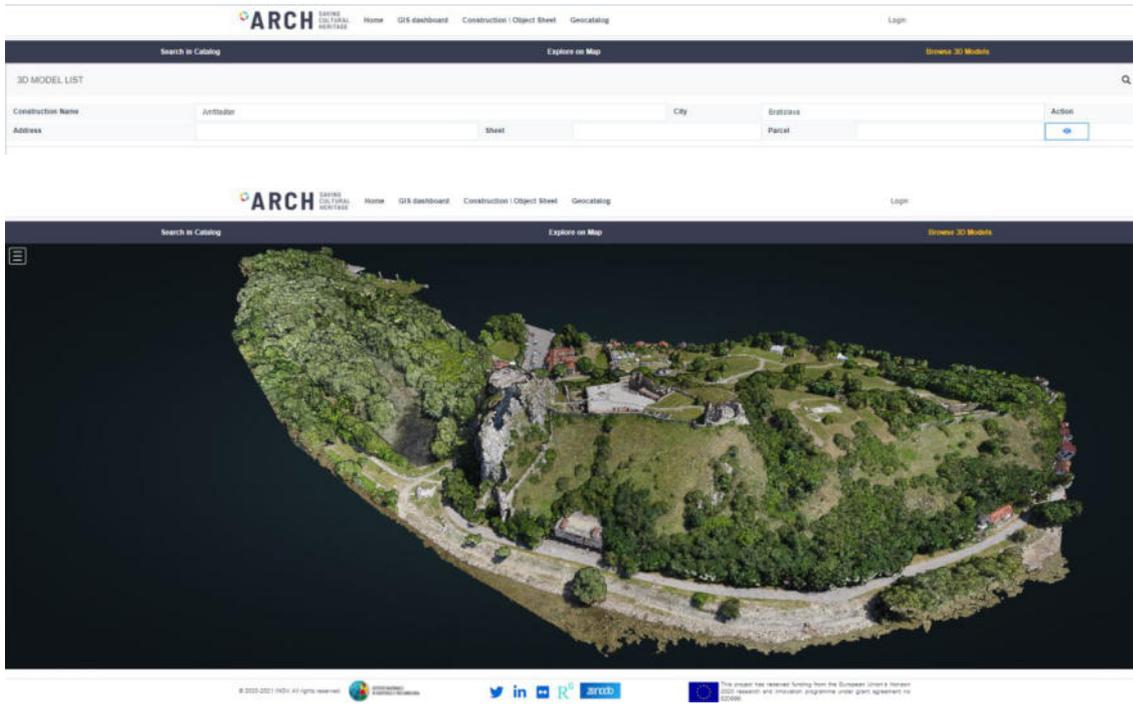


Figure 28. List of the 3D objects in ARCH repository (a) and 3D viewer to navigate the object (b).

Annex C. Metadata of the ARCH Information System

Overall information

Metadata:

File identifier:

1639422125167r18752737530874009

Language:

Language Code:

eng

Hierarchy level:

Scope code:

service

Hierarchy level name:

service

Metadata author:

Responsible party:

Organisation name:

Istituto Nazionale di Geofisica e Vulcanologia

Contact info:

Contact:

Address:

Address:

Electronic mail address:

antonio.costanzo@ingv.it

Role:

Role code:

pointOfContact

Metadata author:

Responsible party:

Organisation name:

TECNALIA

Contact info:

Contact:

Address:

Address:

Electronic mail address:

nieves.pena@tecnalia.com

Role:

Role code:

author

Date stamp:

2021-12-09

Metadata standard name:

INSPIRE Metadata Implementing Rules

Metadata standard version:

Technical Guidelines based on EN ISO 19115 and EN ISO 19119 (Version 2.0)

Reference System Information

Reference system info:

Reference system:

Reference system identifier:

RS Identifier:

Code:

Anchor: xlink: <http://www.opengis.net/def/crs/EPSSG/0/3045>
ETRS89-TM33N

Identification Information

Credit:

The indicators have been produced by Tecnia (<https://www.tecnia.com/>) by combining daily gridded ground observation data over Valencia, derived from the e-OBS dataset (<https://cds.climate.copernicus.eu/cdsapp#!/dataset/insitu-gridded-observations-europe%20?tab=overview>) and the regional EURO-CORDEX (<https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cordex-domains-single-levels?tab=overview>) projections data on single levels available at Copernicus Climate Data Store. The Datasets are processed in cartographic mode by INGV (<https://www.ingv.it/>). "We acknowledge the E-OBS dataset and the data providers in the ECA&D project (<https://www.ecad.eu>). Cornes, R., G. van der Schrier, E.J.M. van den Besselaar, and R.D. Jones. 2018: An Ensemble Version of the E-OBS Temperature and Precipitation Datasets, J. Geophys. Res. Atmos., 123. doi:10.1029/2017JD028200"