D9.6 Report on Standards and Liaison Activities with relevant organizations

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ACRONYMS AND ABBREVIATIONS

BC	Business Continuity
BCM	Business Continuity Management
BCP	Business Continuity Plan
BCS	Business Continuity Strategy
CC	Climate Change
CEN	European Committee for Standardization
CFR	Charter of Fundamental Rights
CH	Cultural Heritage
CoE	Council of Europe
DSA	Decision Services Act
DSS	Decision Support System
ECHR	European Convention of Human Rights
ECI	European Critical Infrastructures
EPCIP	European Programme for Critical Infrastructure Protection
EU	European Union
GDPR	General Data Protection Regulation
GIS	Geographic Information System
GUI	Graphical User Interface
HRAP	Holistic Risk Assessment Platform
IoT	Internet of Things
ISO	International Organization for Standardization
MS	Member States
NIST	National Institute of Standards and Technology
OGC	Open Geospatial Consortium
UI	User Interface
VLOP	Very Large Online Platform
VLSE	Very Large online Search Engine

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Executive Summary

Deliverable D9.6, namely “Report on Standards and Liaison Activities with relevant organizations”, documents the work undertaken in Task 9.5 “Pre-normative and pre-standardization activities – Contribution to European regulations and research”.

A comprehensive assessment of the HYPERION developments is conducted from the standpoint of Standardization, Legal, and Regulatory issues. The report first delineates the current national and EU legal landscape that is mostly relevant to HYPERION, addressing challenges and opportunities related to the protection of fundamental rights and personal data as well as the resilience of National Critical Infrastructure and Cultural Heritage. Subsequently, the compliance of HYPERION with a wide spectrum of standards, laws, and regulations is presented, which played a significant role during the development of project results and directed the execution of on-site assessments, trials, and pilots. Finally, various liaison activities performed by the Consortium are reported, including partners’ participation in meetings with standardization working groups and sister projects.

1 Introduction

1.1 Background

Deliverable D9.6 “Report on Standards and Liaison Activities with relevant organizations” summarizes the work undertaken in Task 9.5, namely “Pre-normative and pre-standardization activities – Contribution to European regulations and research”. A technical standard is an established norm or requirement for a repeatable technical task, which is applied to a common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods, and related management systems practices (Xie et al., 2016). Standardization is the process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards organizations and governments.

1.2 Scope and objective

The overall purpose of Task 9.5 is to report and review the project developments from the standpoint of Standardization, Legal, and Regulatory issues related to technical aspects both at National and European level. Thus, the present deliverable is relevant not only to WP9, but instead has a project-wide scope and is applicable to all activities performed during HYPERION. In brief, the main objective of D9.6 is to:

- Describe the current European legal framework that is mostly relevant to HYPERION, giving heed to issues related to the protection of fundamental rights and personal data, as well as the resilience of National Critical Infrastructure and Cultural Heritage (CH).
- Conduct a comprehensive assessment regarding the compliance of the HYPERION tools and methodologies with a spectrum of national and international standards (both EU and global).
- Assess the compliance of the HYPERION demo events and trials, showcasing that the research studies conducted did not intervene with the historic monuments.
- Report various liaison activities performed by the Consortium, including partners’ participation to meetings with standardization working groups and sister projects for the design of future directives on the protection of CH.

2 General Legal Framework

2.1 Fundamental rights

The European Convention on Human Rights (ECHR) and the Charter of Fundamental Rights of the European Union (CFR, 2000) comprise two legal frameworks that outline the personal, civic, political, economic, and social rights granted to the citizens and residents of the European Union (EU). The ECHR, which was drafted in 1953 by the Council of Europe (CoE), aims to protect human rights and political freedoms while preventing unfair and harmful practices in the EU. Unlike the CFR, which only pertains to the 27 EU Member States (MS), the ECHR is an international convention that extends its reach to all 47 CoE members. In the context of the HYPERION project, all project partners are members of the CoE at thus should comply with the ECHR.

The CFR, which covers a range of human rights related to dignity, freedom, equality, solidarity, and justice, was drafted by the EU in Strasbourg and proclaimed on 7 December 2000 by the European Parliament, Council of Ministers, and European Commission. However, its legal status at the time was uncertain and it only gained full legal effect when the Treaty of Lisbon came into force on 1 December 2009. The CFR falls under the Area of Freedom, Security, and Justice (AFSJ) policy domain of the EU and applies to all bodies of the EU and the Euratom. Any EU legislation or ruling found to be non-compliant with the Charter will be invalidated by the EU's courts.

The HYPERION project concentrates on fundamental rights that are most applicable to its objective of supporting the safety and security of European citizens, with particular emphasis on protecting Cultural Heritage sites and their surrounding communities from a range of man-made and natural perils. All piloting activities took place within EU MS and therefore the CFR is of primary importance when considering fundamental rights. The relevant CFR articles pertaining to Freedoms are Article 7, which concerns the right to private and family life, and Article 8, which relates to personal data protection. Additionally, Article 52 ensures that the CFR is in line with the ECHR.

2.2 General Data Protection Regulation

The General Data Protection Regulation (GDPR) was introduced into EU legislation in May 2018, modernizing and upgrading the principles of the 1995 data protection directive (Directive 95/46/EC, 1995). The GDPR (Regulation (EU) 2016/679, 2016) governs how the personal data of individuals in the EU may be processed and transferred; essentiality, it sets out the specific provisions for ensuring that the fundamental right for personal data protection (Article 8 of the CFR asserts) is safeguarded. In particular, the GDPR defines:

- Individuals' fundamental rights in the digital age;
- The obligations of data controllers and of those processing personal data on their behalf (processors);
- Methods for ensuring compliance;
- Sanctions for those in breach of the rules.

The GDPR pertains not only to the processing of personal information by EU-based establishments, but also the processing of personal information belonging to individuals in the EU, regardless of where the establishment is located (as outlined in GDPR Article 3 - Territorial Scope). Each EU country is allowed to enact specific provisions regarding the implementation of certain aspects of the GDPR (known as opening clauses and derogations). The key principles governing the processing of personal data, including the definition (Article 5), legality (Article 6), consent (Article 7), and the special requirements that apply to the processing of specific categories of personal data, are outlined in Chapter 2 of the GDPR.

The GDPR is applicable to all actions undertaken by the HYPERION project, and any future proposed usage of the HYPERION system within Europe. Throughout the system's creation, both the individual project partners and the Consortium as a whole took measures to adhere to the GDPR requirements. Depending on their implementation, distinct parts of the HYPERION system may process personal data including:

- Data pertaining to secure authentication mechanisms for system users;
- Data acquired from UAVs in the form of images and videos;
- Personal data associated with advanced modelling techniques;
- Data procured from social media platforms to communicate with citizens/visitors;
- Data collected from regional economic accounts to realize the socioeconomic models;
- Personal data collected during demos, trials, and user acceptance tests.

2.3 Protection of National Critical Infrastructure

The European Programme for Critical Infrastructure Protection (EPCIP) serves as the primary basis for enhancing the resilience of critical infrastructure throughout Europe, encompassing all MS and economic sectors. It addresses a variety of hazards, not limited to terrorism, but also including criminal activities, natural disasters, and accidental events, ultimately offering an all-hazards cross-sectoral framework. The activities of EPCIP are supported by regular exchanges of information between MS in the frame of the CIP Contact Points meetings.

A key pillar of this Programme is the Directive 2008/114/EC (2008) that was published by the European Council in 2008 and establishes a procedure for identifying and designating European Critical Infrastructures (ECI), as well as sets a common approach for their assessment, protection, and improvement; however, the Directive has a sectoral scope, applying only to the energy and transport sectors. Nevertheless, it levers the ground for a unified approach to identify CIs and determine their security requirements, recognizing the need for Operator Security Plans (advanced Business Continuity Plans) and nominate Security Liaison Officers (i.e., linking the ECI owner/operator with the national authority responsible for critical infrastructure protection).

The ECI Directive was recently reviewed and found to be insufficient due to the increasing interdependence between critical infrastructure sectors and the evolving risks they face. As these infrastructures become more reliant on each other, disruptions in one sector can cause immediate and lasting effects on operations in

others, ultimately leading to disruptions in essential services. Additionally, given the dynamic political and technical developments occurring in Europe over the past few decades, there is a clear demand for a new EU action to effectively protect critical infrastructure at both the national and EU-wide level.

Along these lines, in late 2020 the European Commission introduced a proposal for a directive (COM (2020) 829, 2020) on the resilience of critical entities, aligning the proposed directive with the EU 2020 Security Union Strategy. Based on this proposal, the Council finally adopted on 8 December 2022 the new Critical Entities Resilience Directive (CER) (Directive (EU) 2022/2557, 2022) along with a recommendation, which together aim to reduce the vulnerabilities and strengthen the resilience of critical entities. MS are required to incorporate the CER Directive's requirements into national law by October 17, 2024. The CER Directive introduces several novel provisions, including:

- The extension of the scope to ten sectors, namely energy, transport, banking, financial market, health, drinking water, wastewater, digital infrastructure, public administration, and space.
- The inclusion of additional natural and man-made risks that may affect the provision of essential services. For cyber security related risks, the same level of protection is ensured by Directive (EU) 2022/2555 (2022).
- A shift in focus, from protection to resilience, i.e., the Directive now emphasizes the ability to not only protect against possible incidents but also to recover and return to full operation.
- The establishment of regulations on supervision and enforcement of critical entities to ensure that the competent authorities can conduct on-site inspections and order audits.
- The possibility for advisory missions for critical entities with European significance, i.e., where a significant number of MS depend on. These missions will consist of teams of experts from different MS who will visit sites and provide recommendations on how to enhance resilience.

Clearly, the EPCIP directives have a significant impact on the HYPERION framework as all tools and methodologies related to the assessment of critical infrastructure must be designed to fully align with these requirements. Specifically, the Holistic Risk Assessment Platform (HRAP) and the underlying Risk and Socioeconomic Engines have been developed with enhanced extensibility capabilities, which allow the efficient simulation of a spectrum of hazard and business classes, as well as the impact assessment of severe disruptions to lifeline services (e.g., transportation, water and power supply, communication) and supply chains. Additionally, the proposed Standard Response Procedures align with EPCIP's focus on increasing adaptability and robustness, by offering state-of-the-art Business Continuity Strategies to enhance business survivability and minimize downtimes on critical services.

2.4 Protection of Cultural Heritage

In Europe, the MS bear the main responsibility for the protection and conservation of their CH, by creating CH-related policies and national legislations that shall be followed by the government, local authorities, public and private organizations,

individuals, etc. These policies and legal frameworks are often in tandem with international and European legislations, such as:

a. The Venice Charter (1964) "International Charter for the Conservation and Restoration of Monuments and Sites", was adopted by the 2nd International Congress of Architects and Technicians of Historic Monuments in 1964 and adopted by ICOMOS in 1965;
b. The Hague International Convention (1970) "For the protection of cultural property in the event of armed conflict", which has been ratified by Law 1114/1981;
c. The Paris International Convention (1970) "Concerning the measures taken to prohibit and prevent the illegal import, export and transfer of ownership of cultural goods", which has been ratified by Law 1103/1980;
d. The European Educational Convention of Paris (1954), which has been ratified by Law 4194/1961;
e. The Paris International Convention (1972) "For the protection of World Cultural and Natural Heritage", which has been ratified by Law 1126/1981;
f. The European Convention of London (1969) "For the protection of Archeological Heritage", which has been ratified by Law 1127/1981;
g. The Declaration of Amsterdam (1975)-Acceptance of the European Charter of Architectural Heritage;
h. The European Convention of Granada (1985), which has been ratified by Law 2039/1992;
i. The UNESCO Recommendation (15/16-11-1989);
j. The Convention of Malta (1992) "For the protection of the Archaeological Heritage";
k. The European Convention of Valletta (2005), which was ratified by Law 3378/2005, "Ratification of the European Convention for the protection of Archaeological Heritage (revised)" (Government Gazette A'203/19.8.2005) and is valid from 11.1.2007.

Under the scope of supporting the actions of the MS and creating a holistic framework for the protection of Europe's CH, EU has developed a series of policies, programmes, and funding, such as the Creative Europe programme, the Horizon 2020, the Erasmus+, and the Europe for Citizens and European Structural and Investment Funds. MS pursue policy collaboration on CH through the Council of Ministers for Education, Youth, Culture & Sport, and through the Open Method of Coordination. Since 2019, the Commission's expert group on CH has been providing advice on the implementation of EU policies for CH. This effort involves MS, associated countries, European cultural heritage networks, civil society organizations, international organizations, and EU institutions.

Finally, one of the most important features at EU level is the European Framework for Action on Cultural Heritage (2018), which reflects the common roadmap for heritage-related activities at a European level. The framework builds upon the achievements of the European Year of Cultural Heritage 2018 and aims to sustain its impact by proposing around 60 actions to be executed by the European Commission in 2019 and 2020. These actions are categorized into five thematic areas: (1) Cultural heritage for an inclusive Europe (2) Cultural heritage for a sustainable Europe (3) Cultural heritage

for a resilient Europe (4) Cultural heritage for an innovative Europe (5) Cultural heritage for stronger global partnerships.

3 Compliance with Standards

At present, national standards (e.g., DIN) are largely being replaced by standards issued by well-established international and European standardization bodies, such as the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN), respectively. ISO was founded in 1946 and is intended to standardize technical rules by simplifying the exchange of goods and removing trade barriers. On the other hand, the purpose of CEN is to coordinate technical rules and laws with the European market. CEN standards, unlike ISO, must be adopted and implemented, as national standards, immediately and without any changes by the corresponding MS according to the decision of the European Council (except from parameters left open for national choice, which are documented in pertinent National Annexes).

3.1 Standards for Structural Design & Assessment

The EN Eurocodes (EN1990, 2002) are a series of ten European Standards, EN 1990 - EN 1999, developed by CEN, which provide a common approach for the design of buildings and other civil engineering works and construction products. EN1990 ("Basis of structural design") is the pillar of the Eurocode framework and establishes the principles and requirements for safety, serviceability, and durability of structures. On the other hand, EN1991 to EN1999 provide specific design regulations that safeguard the accomplishment of the EN1990 principles, covering a range of building materials, hazards, and safety levels.

While Eurocodes comprise the recommended references for technical specifications in public and private contracts in Europe, their range of application has expanded worldwide and are now used for the design of structures outside EU, such as in India, UAE, etc. The ten EN standards are applied in accordance with the National Annexes, which are national standardization documents that contain information on parameters which are left open in Eurocodes for national choice and known as Nationally Determined Parameters (NDP). For instance, specific values for the determination of the wind or seismic hazards can be found in the National Annexes of EN1991 and EN1998, respectively.

In the context of HYPERION, the latest versions of the Eurocodes along with the pertinent National Annexes were used for the structural assessment of Tier-1 to Tier-3 buildings under various natural hazards (e.g., winds, earthquakes, material degradation). Specifically for the seismic studies, HYPERION fully conforms to the 2004 version of Eurocode 8. Moreover, the regional resilience assessments conducted for each HYPERION pilot city were based on a simplified exposure modelling, in which the individual building assets were grouped into building classes, and then distinct fragility and vulnerability functions were used for determining damage levels, losses, and expected downtimes of each class. These functions were based on the European Seismic Risk Model standard (Crowley et al., 2021) for damages and losses, as well as the US HASUS-MH standard for downtimes (FEMA, 2010).

Table 1: Structural Design Standards (CEN).

Standard	Title	Description
EN 1990	Eurocode: Basis of structural design	EC0 establishes Principles and Requirements for the safety, serviceability and durability of structures, describes the basis for their design and verification and gives guidelines for related aspects of structural reliability.
EN 1991	Eurocode 1: Actions on structures	EC1 provides comprehensive information on all actions that should normally be considered in the design of buildings and other civil engineering works, including some geotechnical aspects.
EN 1992	Eurocode 2: Design of concrete structures	EC2 applies to the design of buildings and other civil engineering works in plain, reinforced and prestressed concrete. It provides the requirements for resistance, serviceability, durability and fire resistance of concrete structures.
EN 1993	Eurocode 3: Design of steel structures	EC3 applies to the design of buildings and other civil engineering works in steel. It provides the requirements for resistance, serviceability, durability and fire resistance of steel structures.
EN 1994	Eurocode 4: Design of composite steel and concrete structures	EC4 applies to the design of composite structures and members for buildings and other civil engineering works. It provides requirements for resistance, serviceability, durability and fire resistance of composite structures.
EN 1995	Eurocode 5: Design of timber structures	EC5 applies to the design of buildings and other civil engineering works in timber (solid timber, sawn, planed or in pole form, glued laminated timber or wood-based structural products) or wood-based panels jointed together with adhesives or mechanical fasteners.
EN 1996	Eurocode 6: Design of masonry structures	EC6 applies to the design of buildings and other civil engineering works, or parts thereof, in unreinforced, reinforced, prestressed and confined masonry. The execution is covered to the extent that is necessary to indicate the quality of the construction materials and products that should be used and the standard of workmanship on site needed to comply with the assumptions made in the design rules.
EN 1997	Eurocode 7: Geotechnical design	EC7 shall be applied to the geotechnical aspects OF the design of buildings and other civil engineering works. It provides the requirements for safety and serviceability, describes the basis of design and verification and gives guidelines for related aspects of structural reliability
EN 1998	Eurocode 8: Design of structures for earthquake resistance	EC8 applies to the design and construction of buildings and other civil engineering works in seismic regions. Its purpose is to ensure that in the event of earthquakes

		• human lives are protected; • damage is limited; • structures important for civil protection remain operational.
EN 1999	Eurocode 9: Design of aluminium structures	EC9 applies to the design of buildings and other civil engineering and structural works in aluminium. It provides the requirements for resistance, serviceability, durability and fire resistance of aluminium structures.

3.2 Standards for Software Products

The HYPERION HRAP comprises an integrated risk assessment platform, which aims to assist CH operators and local ephorates with the preservation and protection of historic monuments and sites, as well as city managers and regional authorities with the resilience assessment of their critical infrastructure and supply chains. To deliver its purpose, HRAP employs existing tools and services (e.g., climate/extreme events models and their impacts, decay models of building materials, Copernicus services), novel technologies (terrestrial and satellite imaging for wide-area inspection, advanced machine learning, etc.), and two comprehensive engines that allow the accurate and efficient hazard assessment of CH communities, namely the Risk and Socioeconomic Engines.

The individual components of HRAP exchange information with each other via a lightweight and well-defined communication mechanism, the HYPERION Middleware. The Middleware feeds HRAP with input data and model results, which are finally displayed to the end-users on a user-friendly and efficient GUI supported by the Decision Support System (DSS) of the platform. As one of the objectives of the project is to deploy the integrated HYPERION system in the EU and global market of CH and critical infrastructure protection, the individual components of the system were designed from start-to-finish to comply with many European and worldwide standards related to software products, which are presented in the following sections.

3.2.1 User Interface

The following Table 2 contains a set of ISO standards related to visual user-interface elements (e.g., keyboard layouts, icons, fonts), which were used during the design and development of HRAP and DSS.

Table 2: UI Standards.

Standard	**Description**
ISO/IEC 9995-1:2009	Information technology — Keyboard layouts for text and office systems — Part 1: General principles governing keyboard layouts
ISO/IEC 9995-2:2009/Amd 1:2012	Information technology — Keyboard layouts for text and office systems — Part 2: Alphanumeric section — Amendment 1: Numeric keypad emulation

ISO/IEC 9995-7:2009/Amd 1:2012	Information technology — Keyboard layouts for text and office systems — Part 7: Symbols used to represent functions — Amendment 1
ISO/IEC 9995-9:2016/Amd 1:2019	Information technology — Keyboard layouts for text and office systems — Part 9: Multi-lingual, multiscript keyboard layouts — Amendment 1
ISO/IEC 10741-1:1995/Amd 1:1996	Information technology — User system interfaces — Dialogue interaction — Part 1: Cursor control for text editing — Amendment 1: Macro cursor control
ISO/IEC TR 11581-1:2011	Information technology — User interface icons — Part 1: Introduction to and overview of icon standards
ISO/IEC TS 11581-41:2014	Information technology — User interface icons — Part 41: Data structure to be used by the ISO/IEC JTC 1/SC 35 icon database
ISO/IEC 13251:2019	Information technology — Collection of graphical symbols for office equipment
ISO/IEC 17549-1:2022	Information technology — User interface requirements and recommendations on menu navigation — Part 1: Framework
ISO/IEC 20071-5:2022	Information technology — User interface component accessibility — Part 5: Accessible user interfaces for accessibility settings on information devices
ISO/IEC 23836:2020	Information technology — User interfaces — Universal interface for human language selection
ISO/IEC DIS 23859-1	Information technology — User interfaces — Part 1: Requirements and recommendations on making written text easy to read and easy to understand

3.2.2 Geodata

The Open Geospatial Consortium (OGC) is a global non-profit organization that focuses on creating and promoting standards for geospatial information and technologies. Established in 1994, it has a membership of over 500 organizations worldwide, ranging from government agencies and universities to research institutions and private companies. One of OGC's main achievements is the development of a set of open standards for geospatial data and services, which enable different software applications to share and use geospatial data seamlessly. These standards include the Web Map Service (WMS), which allows users to access and display maps over the internet, the Web Feature Service (WFS), which allows users to query and retrieve geospatial data, the Sensor Observation Service (SOS), which allows users to access real-time sensor data, and the Catalogue Service for the Web (CSW), which supports the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects.

The aforementioned OGC standards are particularly relevant for the design and implementation of HRAP. The platform is built on a Geographic Information System (GIS) and interfaced with hazard assessment software and network simulators to develop an end-to-end simulation platform enabling the execution of disaster scenarios based on real and hypothetical data. Specifically, HRAP is built on top of the

GeoNode project, an open-source Geospatial Content Management System (GCMS) that is part of the OSGeo foundation. The GeoNode, born as a project from the labs of the Global Facility for Disaster Reduction and Recovery of the World Bank, is a web-based platform providing an open-source framework to implement a GIS and a Spatial Data Infrastructures (SDI). Finally, to provide an interoperable mechanism for data and metadata discovery, HRAP employs the pycsw engine, which is the default GeoNode catalogue engine and is an OGC compliant standard based CSW metadata and catalogue component of spatial data infrastructures.

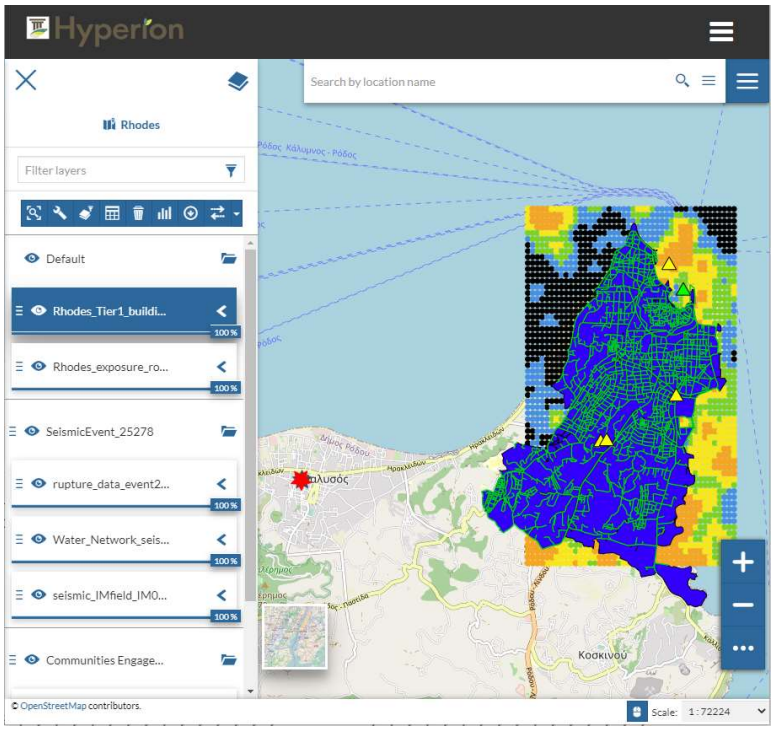

Figure 1: GIS-mapping client for multi-layer interactive maps of HRAP.

3.2.3 Cloud Infrastructures

Due to the increased demand in data storage and computing power, HRAP and Middleware have been designed to support cloud computing. With cloud computing, the users can enjoy high level of scalability and performance by allowing the on-demand allocation of computing resources depending on the scale of their problems, as well as enhanced reliability thanks to the state-of-the-art security policies and disaster recovery plans offered by the cloud providers. The following Table 3 and Table 4 contain a series of cloud infrastructure standards developed by two well-established international standardization bodies, namely the National Institute of Standards and Technology (NIST) and the International Organization for Standardization (ISO), respectively, with which the HYPERION HRAP and Middleware components comply.

Table 3: Cloud Infrastructure Standards (NIST).

Standard	Description
NIST SP 500-291 (2011), NIST Cloud Computing Standards Roadmap	This describes the existing standards landscape for security, portability, and interoperability standards/models/studies/use cases, etc., relevant to cloud computing.
NIST SP 500-293 (2011), U.S. Government Cloud Computing Technology Roadmap	It contains ten high-level priority requirements in security, interoperability, and portability for the government's adoption of cloud computing.
NIST SP 800-144 (2011), Guidelines on Security and Privacy in Public Cloud Computing	This standard provides guidance and recommendations for implementing a secure environment in public cloud services.
NIST SP 800-145 (2011), The NIST Definition of Cloud Computing	This standard delineates key features of cloud computing and serves as a benchmark for evaluating various cloud services and deployment approaches. It also provides a foundation for discussions concerning the salient characteristics of cloud computing and the most effective ways to use it.
NIST Standards Acceleration to Jumpstart Adoption of Cloud Computing (SAJACC)	The goal of SAJACC group is to accelerate the adoption of cloud computing by providing a framework of standards and guidelines that address the security, privacy, interoperability, and reliability challenges associated with cloud-based systems. SAJACC includes a set of guidelines for assessing cloud service providers and their offerings, as well as a reference architecture for cloud-based systems.
NIST Cloud Computing Program (NCCP)	The NCCP program is a government-led initiative aimed at promoting the adoption of cloud computing technologies by both public and private sectors. The program provides guidance, standards, and best practices for the secure and effective deployment of cloud computing systems.

Table 4: Cloud Infrastructure Standards (ISO).

Standard	Description
ISO/IEC 17789:2014, Information technology – Cloud computing – Reference architecture	This specifies the cloud computing reference architecture (CCRA), comprising the cloud computing roles, activities, and functional components as well as their interaction.
ISO/IEC 17826:2016, Information technology – Cloud Data Management Interface (CDMI)	This document specifies the interface to access cloud storage and to manage the data stored therein. It applies to developers who are implementing or using cloud storage.
ISO/IEC 18384:2016, Information technology – Reference Architecture	This standard provides the framework for SOA, consisting of three parts that discuss

for Service Oriented Architecture (SOA RA)	terminology and concepts for SOA, reference architecture, and SOA ontology.
ISO/IEC 19086-1:2016, Information technology – Cloud computing – Service level agreement (SLA) framework.	This standard establishes a set of common cloud SLA building blocks (concepts, terms, definitions, contexts) that can be used to create cloud SLAs.
ISO/IEC 19941:2017, Information technology – Cloud computing – Interoperability and portability	This standard specifies the interoperability and portability aspects of cloud computing.
ISO/IEC 19944-1:2020, Cloud computing and distributed platforms – Data flow, data categories and data use	This standard describes how data moves among cloud service vendors and users of cloud services.
ISO/IEC Technical Report 22678:2019, Information technology – Cloud computing – Guidance for policy development	This standard provides guidance for utilizing international standards as a means to create policies and regulations for cloud service providers (CSPs) and cloud services, as well as policies and practices for using cloud services within organizations.
ISO/IEC Technical Specification 23167:2020, Information technology – Cloud computing – Common technologies and techniques	This standard describes technologies and techniques used in cloud computing, including VMs, hypervisors and containers.
ISO/IEC 27017:2015, Information technology – Security techniques – Code of practice for information security controls based on ISO/IEC 27002 for cloud services	This document offers guidelines on information security controls that are relevant to the utilization and delivery of cloud services. It provides (a) additional implementation guidance for relevant controls specified in ISO/IEC 27002 and (b) additional controls with implementation guidance for cloud services.
ISO/IEC 27018:2019, Information technology – Security techniques – Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors	This document specifies guidelines based on ISO/IEC 27002, focusing on the protection of PII in public cloud environments.

3.2.4 Information Security

Transmission of information across the HYPERION platform is implemented via the HTTP (Hypertext Transfer Protocol) and MQTT (Message Queuing Telemetry Transport) protocols. HTTP, the foundation of data communication in the World Wide Web, comprises a communication protocol used for transmitting data over the internet and it serves as a request-response protocol between clients and servers. On the other hand, MQTT (Message Queuing Telemetry Transport) is a lightweight messaging protocol designed for machine-to-machine (M2M) communication. In HYPERION, communication of the protocols HTTP and MQTT occurs over an encrypted channel, while resources are accessible only by authorized users and

components, as defined by the information security management system of the platform.

The main objective of information security is to ensure confidentiality, integrity, and information availability (ISO/IEC 27000, 2018); these principles were adopted when defining the security requirements of the HYPERION platform, i.e., of the underlying HRAP and Middleware systems. Confidentiality is intended to prevent **unauthorized reading** of information, meaning that each user has access only to the resources allowed by his permissions. Integrity on the other hand aims to prevent **unauthorized modification** of information, i.e., a user cannot modify data that permissions do not allow it. Finally, the purpose of availability is to make the technology infrastructure, the applications, and the data **available when they are needed** for an organizational process or for an organization's customer.

To ensure the security of the systems, the aforementioned basic pillars of the information security must be applied in combination. Confidentiality is satisfied by all components of the HRAP platform as users who want to publish data via MQTT or use the middleware API to store or receive data, must first complete the authentication process by logging in to the system with their credentials. Moreover, integrity is safeguarded in the case of Middleware by establishing an encrypted communication channel such as TLS (Transport Layer Security) to secure the HTTP traffic. This ensures reasonable protection from eavesdroppers, man-in-the-middle attacks, and the integrity of the data. For the HTTP requests authorization, the HYPERION system applies the OAUTH 2.0 Authorization Framework (Jones and Hardt, 2012). Finally, availability is ensured by the high redundancy of the employed computing systems, sensors, security controls, and communication channels.

3.2.5 Social Media

EU has been a leader in drafting a number of internet and social media laws pertaining to content moderation, such as the removal of illegal and harmful content, the establishment of processes for reviewing and appealing content moderation decisions, the imposition of transparency obligations on platforms' terms of service, and regulations governing the algorithms used to facilitate content moderation practices. Along these lines, the EU Council approved in July 2022 the Digital Services Act (DSA) (Regulation (EU) 2022/2065, 2022) to establish accountability criteria for online platforms and impose more extensive responsibilities on "very large" platform operators. It is noteworthy that this legislation will apply to all providers operating in the EU, irrespective of their location, ensuring that all EU residents are completely safeguarded under the DSA's purview. The law is being executed in phases, with companies being given the 1st of January 2024 as a due date to comply.

The DSA defines different levels of requirements depending on the size of the tech companies, by splitting them into tiers. The most heavily regulated tier is reserved for Very Large Online Platforms (VLOPs) and Very Large online Search Engines (VLSEs) with more than 45 million monthly active users. It is very likely that this tier will include big players of the IoT industry such as Facebook, Instagram, Google, TikTok, and Amazon. VLOPs will have to perform an annual risk assessment to identify harmful content risks, such as disinformation, misogyny, child endangerment, and election manipulation. In case these risks are characterized unacceptable, the

companies must also implement measures to reduce them, although most of the major social media platforms and search engines already employ specialized teams for content moderation. Finally, big platforms must also provide an independent audit of their compliance with the act and report the number of personnel involved in content moderation.

While in EU the social media legislation is relatively uniform among MS, in the US the legal landscape is more fragmented, as the regulations are currently being decided and implemented at the state level. Since 2020, over 250 bills have been introduced across all 50 states according to the Computer & Communications Industry Association (CCIA), including the AB-587 (2022) in California, the HB 20 (2021) in Texas, and the SB 7072 (2021) in Florida. Lately, proposals are made for the adoption of content moderation regulations in a federal level to prevent legislation inconsistencies, by reforming the Communications Decency Act (CDA), which was established in 1996 to regulate internet content premised on freedom of the internet.

The aforementioned EU and US legislations were taken into account during the design and development of the HYPERION Mobile App tool. The tool comprises an open-source social platform (available in Android and IOS) specializing in the preservation and promotion of everyday all-around heritage, using crowdsourced techniques. It allows the citizens to create stories of local cultural knowledge and experiences, report possible deteriorations and corrosions, geo-locate the site and provide specific information. The target market of the app consists of tourists and residents of CH sites around the globe, and thus, the number of active users is expected to increase rapidly after its deployment. Thus, the DSA requirements pertaining to small-to-medium social platforms were considered, including user complaint handling, removal of illegal content, ads and algorithms transparency, etc.

3.3 Standards for Insurance Policies and Business Continuity

As not all hazards can be averted, enhancing business resilience by adopting efficient Business Continuity Plans (BCPs) currently comprises the state-of-the-art approach for risk mitigation. BCPs are designed (a) to reduce the impact of a crisis and (b) to rapidly restore conditions to return to the so-called “Business as Usual” state. While international BC standards, such as the ISO 22301 (ISO 22301, 2019), specify some general requirements to implement, maintain and improve resilience, there is no single recommended plan for improving BC. Instead, every organization needs to develop its own dynamic BCP based on its unique characteristics. BCP are designed and implemented by the organization’s Business Continuity Management (BCM), which refers to a holistic management process that identifies potential threats to an organization and the impact on business operations that those threats, if occurred, might cause; essentially, BCM provides a framework for building BC.

The concept of BC and BCM can be extended from an organizational- to a regional-scale level by designing and implementing comprehensive Business Continuity Strategies (BCS), which are sector-wide plans that can enhance business survivability and ultimately protect local economies. Essentially, BCSs can be employed to deliver the principles of the new EPCIP directive, by strengthening the resilience and adaptability of modern societies against adverse events. In the context of HYPERION,

four BCSs were proposed and tested in the Socioeconomic Engine developed by RG, which are reported in Deliverables 7.2 and 7.3. The developed engine comprises a promising risk assessment tool that goes beyond the current state-of-the-art, by offering the ability to simulate and assess in a quantitative manner the impact of various disaster scenarios to a community and the effectiveness of different recovery strategies. Thus, we expect that in the following years the tool will be prolific in many scientific fields and that it will influence the design of future directives related to BC and protection of critical infrastructures.

4 Legislation for the Pilot Demo Sites

4.1 Granada

Spain has implemented a range of policies to protect its CH, recognizing the importance of preserving its rich history and diverse cultural assets. The protection of CH in Spain is primarily regulated by national legislation, regional laws, and international agreements, such as:

- National Heritage Law: The principal legal framework governing the protection of CH in Spain is Law 16/1985 on Spanish Historical Heritage. This law establishes the necessary guidelines for safeguarding, conserving, restoring, and promoting CH throughout the country.
- Cultural Property: Spanish legislation recognizes various forms of cultural property, encompassing monuments, archaeological sites, historic buildings, movable artworks, archives, libraries, and museums. These properties are considered integral components of Spain's CH and benefit from legal protection.
- Declarations and Cataloging: Spanish authorities undertake the identification and declaration of specific properties as "Cultural Interest" (Bien de Interés Cultural, or BIC). This designation confers legal protection upon the properties, ensuring their preservation and upkeep. BIC properties can include architectural ensembles, historical sites, and movable or immovable cultural assets.

Figure 2: Smart tags installed on the “San Jerónimo Monastery” site (Granada).

In the context of HYPERION, detailed vulnerability assessments have been conducted in several Tier-1 and Tier-3 assets located in Granada, with the goal to identify potential structural weaknesses and to evaluate the effect of material degradation under different Climate Change (CC) scenarios. To increase the accuracy of these assessments, the performed numerical analyses were extensively calibrated by experimental results and data from various sensors. For instance, the San Jerónimo Monastery (Tier-1) was instrumented and modelled in detail. Specifically, (i) laser scanners were used as a novel non-destructive technology for deriving the point clouds for the interior and the exterior of the Monastery, (ii) vibration testing was

conducted for the identification of its dynamic properties, and (iii) smart tags were installed to measure important micro-climatic stressors (Figure 2). All instrumentations were performed with the guidance of the pertinent pilot partners, CH operators, and local authorities to fully respect the current regulatory framework that exists in Granada regarding the protection of CH.

4.2 Rhodes

In Greece, the protection, preservation, and restoration of cultural heritage is ensured through the provisions of the Constitution, specifically under the Act of no.24. More importantly, a centralizing means used by the competent Departments of the Ministry of Interior is Law 4858/2021, "Sanction of the Code of Legislation for the Protection of Antiquities and Cultural Heritage in General", which codifies the relevant legislation and jurisprudence. However, there are laws and decrees concerning individual issues such as:

- The declaration and protection of areas and individual monuments and archaeological sites both by the Ministry of Culture and by other Ministries such as the Ministry of Environment and Energy, the Ministry of Aegean and Island Policy (now emerged with the Ministry of Transport Infrastructure and Networks), the Ministry of Interior (Macedonia-Thrace sector), and others.
- The characterization of island areas and settlements as "traditional" through the Presidential Decree (PD) 19-10-1978-Official Gazette 594/D/13-11-1978 "On the classification as Traditional Settlements of the State and defining the conditions and restrictions of construction on these plots of land."
- The PDs concerning the definition of specific terms and conditions for the restoration and protection of the monuments, for example Corfu (as a World Cultural Heritage monument)

It should be noted that Greek National Legislation is in accordance with a plethora of International and European legislations concerning the protection of CH, such as the Hague International Convention (1970), the Paris International Convention (1970), and the Convention of Malta (1992). Reference to the protection of CH within a manmade environment is made, with which the Greek Legislation is in accordance with:

- In no.191 of the Treaty on the Functioning of the European Union;
- Regulation 3911/1992 (EEC) on the export of cultural goods;
- Directive 93/7 EEC regarding the return of cultural goods that have been illegally removed from the territory of a member state;
- Directive 85/337EEC regarding the assessment of the effects of certain public and private projects on the environment;
- Directive 97/11/EEC (amended 87/337/EEC) and 2001/42/EC regarding the strategic assessment of the environmental impacts of plans and programs.

In the context of the HYPERION project, several CH sites located in the island of Rhodes were assessed by means of experimental and analytical investigations. Such tests required the continuous monitoring of various environmental stressors (e.g., temperature, humidity, solar radiation) in order to evaluate their short- and long-term impact on the material properties and structural integrity of the CH assets. For

instance, innovative smart tag devices were emplaced on the “Saint Nicolas” and “Nailac Tower” sites (Figure 3), whose installation was fully aligned with the pertinent national and EU legislation regarding human intervention on protected CH sites.

(a) (b)

Figure 3: Sensors installed on (a) the “Saint Nicolas” and (b) the “Nailac tower” sites (Rhodes).

4.3 Tønsberg

The Cultural Heritage Act (Act of 9 June 1978 No. 50 Concerning the Cultural Heritage) is a Norwegian law that protects the archeological and architectural monuments and sites, and cultural environments in all their variety and detail, both as part of Norway’s Cultural Heritage and identity and as an element in the overall environment and resource management. According to the Act:

“It is a national responsibility to safeguard these resources as scientific source material and as an enduring basis for the experience of present and future generations and for their self-awareness, enjoyment and activities.”

During HYPERION, a comprehensive study was conducted on several important CH assets located in the city of Tønsberg to evaluate the impact of various hazards such as material degradation and CC effects. The first asset (Figure 4) comprises the “Heiertstad loft”, which is a Tier-1 asset and was built in AD 1406-07 (the date of construction is exact as it was derived through dendrochronology). The loft was originally used for storage of food supplies, seed grain, clothes etc.

Section 4 of Chapter II of the Act identifies several monuments and sites constructed earlier than AD 1537 and which are automatically protected by the law. The list includes settlement sites, caves, natural rock shelters with evidence that people have lived or worked there, sites of dwellings or churches, churches, houses and structures of all kinds, etc. “Heiertstad loft” falls to this category and, thus, the relevant provisions foreseen by the Act shall be followed for all monitoring, protection, and preservation works.

Figure 4: The “Heiertstad loft” CH site (Tønsberg).

Figure 5: The “Slottsfjell Tower” CH site (Tønsberg).

The second CH building, the “Slottsfjell Tower”, is a reconstruction of a medieval tower (campanile) and was built in 1888 to commemorate the millennium of the founding of Tønsberg as Norway’s oldest town. While the structure was built in the post-medieval era, it is still treated with the same regulations as the “Heiertstad loft” due to its location and the fact that it belongs to a protected and listed cultural environment. In addition, Section 15 of Chapter V of the Act states that “The Ministry

may protect structures and sites or parts of these which are valuable architecturally or from the point of view of cultural history".

Section 3 of Chapter II of the Act states that:

"No person shall, unless this is lawful pursuant to section 8, initiate any measure which is liable to damage, destroy, dig up, move, change, cover, conceal or in any other way unduly disfigure any monument or site that is automatically protected by law or to create a risk of this happening."

Moreover, according to Section 8 of the same Chapter:

"Anyone intending to initiate measures which may affect an automatically protected monument or site in a manner described in section 3, first paragraph, must notify the competent authority or the nearest police authority as early as possible before it is planned to put the measures into effect. The competent authority shall decide as soon as possible whether and if so in what way the measures may be carried out. An appeal against the decision may be made to the Ministry within 6 weeks of the date notification of the decision reaches the addressee."

The risk and hazard assessments performed in the context of HYPERION required the continuous monitoring of the two sites through the employment of various sensor devices. Such sensors shall fulfill the requirements foreseen by the Norwegian Cultural Heritage Act regarding the prohibition against disturbing monuments and sites which are (or treated as) automatically protected. Indeed, the installed smart tags are innovative low-cost sensors that allow the precise data acquisition of various atmospheric stressors (e.g., humidity, temperature), while at the same time do not intervene with the CH building/asset (no drills, anchors, etc.).

(a) (b)

Figure 6: Installed smart tag on (a) the "Heiertstad loft" and (b) "Slottsfjell Tower" sites (Tønsberg).

Finally, the Norwegian Civil Protection Act and EEA Agreement (between EU and Norway) was changed in 2012 by incorporating the EPCIP Directive regarding the protection of critical infrastructure. The hazard and vulnerability assessments performed in the Tønsberg pilot city were fully in tandem with EPCIP, as the primary objective of the project was to enhance the resilience of CH sites and their surrounding communities, which comprises one of the key principles of the directive.

4.4 Venice

The Legislative Decree n.42 (2004) "The Code of Cultural Heritage and Landscape" delineates the main legal framework for the protection and preservation of CH in Italy. The Decree is in tandem with many European and international laws concerning heritage sites, such as the Venice Charter (1964) and the Hague International Convention (1970). The role of municipalities and local authorities is explicitly stated in Article 1 ("Principles") of the Decree:

"The State, the Regions, the Metropolitan Areas, the Provinces and Municipalities shall ensure and sustain the conservation of the cultural heritage and foster its public enjoyment and enhancement."

The same Decree also provides a series of regulations that shall be followed by the Ministry and the local superintendents and operators when performing inspection (Article 19, "Inspection") and conservation (Article 29, "Conservation") activities on CH sites. The execution of such activities can be supported by the collaboration between local authorities and research institutes as per Article 118 ("Promotion of Study and Research Activities"):

"The Ministry, the Regions and other territorial government bodies shall, with the possible participation of universities and of other public and private entities, carry out, promote and support research, studies and other cognitive activities related to the cultural heritage, and may do so jointly"

During the HYPERION project, a series of sensors and data collectors were emplaced on the "St Mark's Clocktower" site to assess the impact of microclimate conditions on the building materials of the structure. As illustrated in Figure 7 and Figure 8, the installation of these devices was implemented with plastic cables and other non-intervening means and, thus, fully conforms to the Italian laws concerning inspection and conservation activities on CH sites. Moreover, all activities were done with the consent of the local ephorates and municipal authorities of Venice, which were reportedly informed about the progression of the works.

The design and construction of structures in Italy is based on the Italian Building Code (NTC, 2018) and the EN Eurocodes (EN1990, 2002). These codes were used as the main framework for the execution of all structural assessments conducted during the Venice pilots, from the asset- up to the city-scale studies. Finally, while not explicitly used in the project, the Venice Municipality Building Regulation (2019) and specific national standards set additional regulations that apply to the city of Venice (historical centre) regarding the restoration of buildings of historical architectural value.

(a)

(b)

(c)

Figure 7: Installed sensors on the “St Mark’s Clocktower” site (Venice), showing (a) the position of the sensors on the external wall of the tower, (b) an installed datalogger, and (c) an installed smart tag.

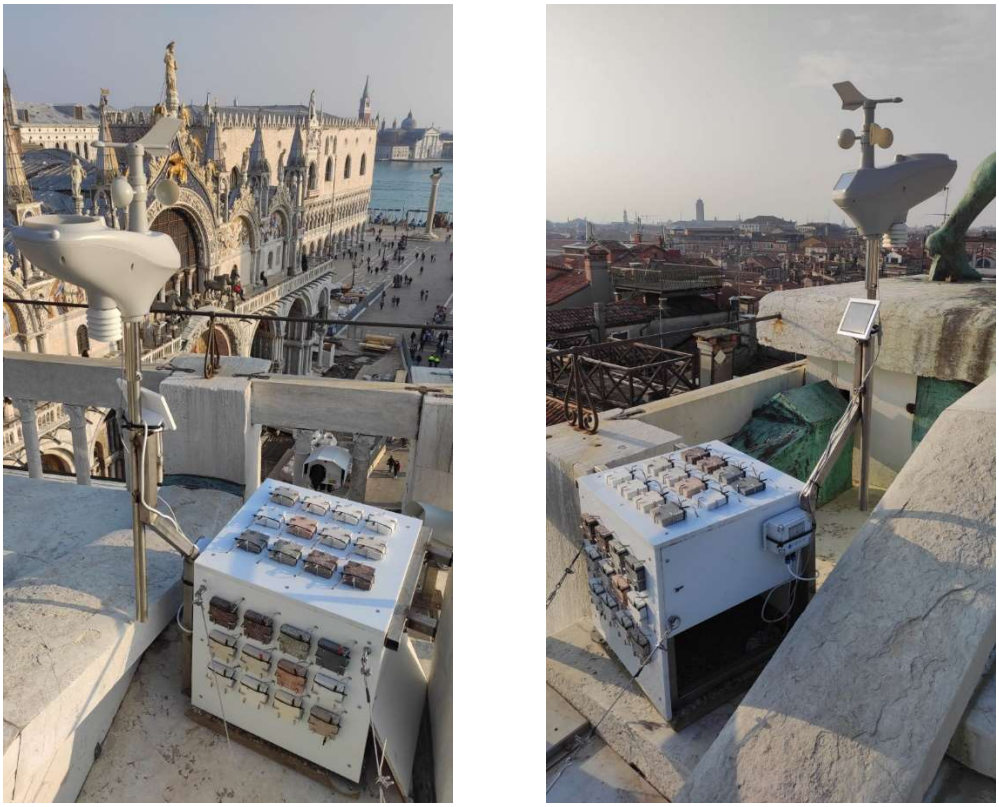

Figure 8: Installed data cube on top of the “St Mark’s Clocktower” site (Venice).

5 Liaison Activities

Liaison activities are defined as actions that include two or more parties, aiming in adding value, through information exchange between the partners. Liaison is not identical to dissemination, as it pertains only to activities in which there is interaction between two or more parties and the information exchange favors one or both of the involved parties. Throughout its lifetime, HYPERION has engaged in numerous collaborations with other project consortia, both from previous and ongoing projects, as well as contributed to several conferences, workshops, committees, joint papers, etc., which are comprehensively reported in the Dissemination Plan of the project.

Apart from joint meetings and participation in relevant conferences, HYPERION has collaborated with two H2020 projects working on similar and complementary topics, namely ARCH and SHELTER. The Project Group that was formed by these three projects participated in several meetings with experts from the Horizon Results Booster services to strengthen their dissemination actions, identify the exploitation potential of their results, and ultimately define a common roadmap on the protection and preservation of Europe's rich cultural heritage.

Moreover, the group established on June 2021 an EU Task Force for Climate Neutral and Resilient Historic Urban Districts in response to and support of the Horizon 2020 "Heritage Alive" orientation to "[increase] resilience and sustainable reconstruction of historic areas to cope with climate change and hazard events", following in the footsteps of earlier projects like STORM and HERACLES. The mission of the EU Task Force was to co-ordinate EU efforts to make historic and contemporary urban districts climate neutral and strengthen their resilience to the effects of CC and natural hazards as well as the resilience of the communities depending on those areas. The Task Force brought together actors from practice, research, and policy to foster the development and uptake of advanced solutions for resilient urban planning for historic urban districts, supporting their adaptation to CC and making them climate neutral. In doing so, the task force aimed to provide support to European authorities and decision makers for developing common evidence-based policies, strategies, and procedures. To achieve this goal, the Task Force focused on three thematic areas:

- Developing resilience strategies for historic urban districts;
- Developing harmonized approaches for assessing and monitoring risk and resilience;
- Developing equitable solutions for and with communities.

The technical core of the Task Force was made up of partners from European research projects in the fields of heritage management, CC mitigation/adaptation, disaster risk management/resilience as well as urban planning and regeneration. In addition, practitioners, decision makers and policy actors on European, national, and local level in those fields participated in the task force to discuss solutions offered by the technical partners and ensure their applicability.

The Task Force implemented three meetings on the following dates:

- Kick-off Meeting: June 23, 2021;
- Second Meeting: December 14-15, 2021;

- Third Meeting: June 3, 2022.

The main findings contributed to the creation of a concept paper (available in the HYPERION website), which included the following topics:

- A Resilience Framework developed into a CEN Workshop Agreement;
- Methods and tools for assessing the resilience of historic districts;
- Research and policy recommendations to address resilience challenges facing historic districts.

Regarding the participation of HYPERION to Technical Committees, throughout the duration of project the Eurocodes have been in a state of evolution, reaching their near-final (public enquiry) version at the end of 2022 under the guidance and co-ordination of CEN Technical Committee 250 (CEN/TC250). Through the participation of the NTUA team to CEN/TC250, HYPERION has enjoyed a direct link to the latest developments in structural design and assessment, and has had the chance to influence the direction of their evolution, especially regarding the damage to all-important ancillary elements and non-structural components (e.g., HVAC equipment, electrical panels, suspended ceilings, valuable contents, etc.) to reduce the magnitude of seismic losses throughout Europe.

6 Conclusions

Deliverable D9.6 addressed critical legal, regulatory, and standardization issues that majorly affected the development of the HYPERION ecosystem. A series of directives and laws related to the protection of personal data (e.g., GDPR), critical infrastructure (e.g., EPCIP), and cultural heritage (e.g., Venice Charter) was reported, which were adopted by the Consortium to enhance the project's transparency under the dynamic environment of the Industry 4.0 era. Subsequently, the compliance of HYPERION with national and international standards was assessed, which showcased that the project outcomes are in tandem with the current state-of-the-art in policy making, software development, and security. Finally, the report presented several liaison activities performed by the Consortium, including participation to workshops and conferences, collaboration with sister projects under the auspices of the Horizon Results Booster services and EU Task Force, and involvement in standardization activities with well-established standardization bodies.

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