D2.2 Definition of System Requirements, Use Cases and KPIs Specification

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[1] **R**=Document, report; **DEM**=Demonstrator, pilot, prototype; **DEC**=website, patent fillings, videos, etc.; **OTHER**=other

[2] **PU**=Public, **CO**=Confidential, only for members of the consortium (including the Commission Services), **CI**=Classified, as referred to in Commission Decision 2001/844/EC

Modifications Index

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28/11/2019	0.1 TOC
18/02/2020	0.2 First draft circulated to partners
05/03/2020	0.3 Tables for system requirements, use cases added
12/03/2020	0.4 Functional vs Non-functional requirements
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ACRONYMS AND ABBREVIATIONS

DSS	Decision Support System
FC	Functional Requirement
HRAP	Holistic Risk Assessment Platform
KoM	Kick-off Meeting
KPI	Key Performance Indicators
NFC	Non Functional Requirement
STO	System's Technical Objective
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
WP	Work Package

Table of Contents

Executive Summary

This deliverable includes the complete set of system-level requirements for the Hyperion platform, the use cases for the field trials of the platform as well as the specification of the Key Performance Indicators (KPIs) for the validation the platform.

The deliverable is mainly intended for providing information to partners involved in the development of the Hyperion components and – at a later stage – to WP8 for assessment purposes.

Each requirement includes a number of attributes, used to identify the type of the requirement, provide a description as well as the way to test the fulfilment of the requirement, identify the partner(s) in charge of ensuring that the requirement is met and the priority/importance of the specific requirement implementation.

In addition, the deliverable presents possible use cases for the field trials (WP8) and quantitative ways of validating the platform's performance.

1. Introduction

1.1 Background

Deliverable 2.2 is a “Report containing the detailed specification of HYPERION platform functional and Non-functional requirements, as well as use cases and KPIs that will be used for validation.”

By system-level requirements we understand a set of documentation that describes the features and behaviour of a system or software application. System-level requirements include a variety of elements that attempts to define the intended functionality required by the customer to satisfy their different users.

By use cases we understand a set of scenarios that describe how the platform should interact with the interested stakeholders in order to comply with the functional requirements.

By KPIs we understand a set of quantifiable measurements that can be used to validate the performance of each component as well as the platform as a whole. A set of critical, measurable parameters are established to test the compliance of the platform to the requirements.

1.2 Purpose and scope

The document represents the starting point for the definition of the HYPERION platform architecture as well as the development and implementation of the components. The requirements identified and analysed in this document will be used to ensure that the platform respects the intended use and can effectively provide value to the various classes of end users involved. The use cases and the KPIs will be used in the evaluation phase for assessing the ability of the artefacts developed to effectively meet the requirements set forth in the following sections.

1.3 Approach

The starting point for the preparation of D2.2 has been D2.1, which described in detail the needs of the pilot cities and the hazards that can affect the study areas.

2. Methodology and process

In this chapter the overall methodology to be followed in order to identify the system requirements and the pilot scenarios is presented. The steps that are followed as well as the intermediate results are presented in detail in the following paragraphs.

2.1 High-level methodology

The starting point for the analysis of requirements was D2.1, which included a detailed description of the users' needs. User needs were the output of an extensive collaboration between the technical partners and the end users of the Hyperion project, over two extensive workshops, held in conjunction with the KoM and the first plenary meeting as well as multiple teleconferences. The main goal of this process was to ensure the Hyperion system will comply with the user needs, provide a sustainable solution, and support the government and the local authorities with the management and improved resilience of the Cultural Heritage monuments.

Initially, the system personas were identified and the use cases, converting user needs to scenarios, were developed.

Next, technical partners were asked to devise an initial set of system requirements, taking into account the users' needs as consolidated in D2.1, the identified personas as well as the use cases. The requirements were structured in a uniform way ensuring that they are well defined, have a responsible partner and some validation means.

Furthermore, the input provided by the technical partners was consolidated ensuring that all user needs were covered by the identified requirements and that there were not multiple requirements addressing the same needs.

In addition, a detailed analysis of the requirements was conducted to ensure that no conflicts were present between them. Following that, the harmonized requirements were presented to the end users, ensuring that the requirements were complying with their needs.

Finally, based on the validation means for the identified system requirements a series of KPIs were specified that will be used to evaluate the performance of the system.

2.2 Personas

A persona is defined as a fictional character that it is used to represent a group of users and/or stakeholders and are used in the description of the use cases to assist in the identification of system requirements. Hyperion personas have specific roles, in the government, the community and the general public, that are relevant to the project.

By relevant to the Hyperion project we are referring to people that are:

- Directly involved in the acquisition of the input;
- Direct beneficiaries from the outputs;
- Indirect beneficiaries from the outputs;
- Interested parties in the project objectives;
- Indirectly affected by the project outcomes.

High level government authority (Alex)

- A highly respected government authority;
- An archaeologist with years of experience;
- The Minister of Cultural Heritage;
- Responsible for major decisions related to the country's CH management;
- Responsible for the allocation of the budget;
- Interested in protecting monuments that are in serious need;
- Needs to have a full understanding of the situation in order to make a decision.

Figure 1 Alex, a high-level government authority

Regional authority (Rebecca)

- A respected regional authority;
- A manager with experience in different domains;
- The General Manager of the region (Tier 3);
- Responsible for all day-to-day activities related to the regional sites;
- Responsible for managing the allocated budget;
- Can make small decisions about important actions within the budget;
- Needs to have a complete justification for every decision made.

Figure 2 Rebecca, a regional authority

Local authority (Martha)

- A respected local authority;
- A civil engineer with years of experience in the maintenance of CH sites;
- Responsible for one specific CH structure (Tier 1) or an ensemble of CH or non-CH structures in close proximity (Tier 2);
- Responsible for noticing and recording all activities related to these buildings (deterioration, new hazards, vandalisms, new cracks);
- Enjoys researching & implementing new ways to help the sites.

Figure 3 Martha, a local authority

Local resident (Donald)

- A local resident;
- Has many interests;
- Participates in many communities;
- Has little to None interest in technological advantages;
- Is interested in the local history, the CH and has many interesting stories to tell about the area;
- Appreciates all the efforts done to improve & maintain the CH sites of his city.

Figure 4 Donald, a local resident

Local Business owner (Nicole)

- A local resident & owner of a local business;
- Works hard in a local tourist shop selling handmade keychains;
- Has very limited free time;
- Does not participates in any communities;
- Is technically savvy;
- Accepts efforts to maintain the CH sites but does not want them interfering with her work.

Figure 5 Nicole, a local business owner

Regional Financial Administrator (Mark)

- Regional resident;
- Responsible for supplying the region with goods;
- Responsible for distributing the goods to local areas within the region;
- Work very hard & have very limited free time;
- Indifferent towards the maintenance of the CH sites but interested in the business continuity models.

Figure 6 Mark, a regional financial administrator

Utility Operator (Nick)

- Regional resident;
- Head of a utility company (water, power, sewage or transportation);
- Responsible for the smooth operation of the company, the provision of the goods and services to the consumers and the planning of infrastructure to ensure resilience from natural and man-made hazards.

Figure 7 Nick, a utility operator

UAV service provider (Gloria)

- Can be a local or regional resident;
- Representing innovative ideas;
- Carrying UAVs in different shapes & sizes;
- Works only when the weather allows it;
- Needs to fill in forms & get permissions every time that a test is scheduled;
- Loves all things related to cameras, recording & monitoring.

Figure 8 Gloria, a UAV service provider

Hyperion Engineering Services Provider (David)

Figure 9 David, Hyperion Engineering Services Provider

- Not a local or regional resident;
- Has studied/modelled/monitored the area of interest;
- Carrying a lot of equipment to monitor the CH sites;
- Work very hard & thinks even harder;
- Dedicated to the protection of the CH sites from all their enemies (natural & man-made disasters);
- Responsible for keeping the models up-to-day, update them when/as needed;
- Responsible to ensure proper monitoring & prediction of consequences.

3. Use Cases

The use cases relevant to the Hyperion project are classified into three main categories based on their time relation with the examined event, the knowledge available during the event and the time frame for any mitigation actions.

In detail, the use cases are characterized based on their time relation with the examined event as:

- ***Pre-event***, the system is tested on scenarios that are probable to be materialized aiming to identify vulnerabilities and mitigation actions that will improve the resilience of the examined area.
- ***Trans-event (Near real time)***, the system is tested on a scenario that has just been materialized, or is still in progress, aiming to identify possible issues/damages and improve the response time of the authorities to the event.
- ***Post-event***, actions that can take place after the end of an event, as a warning for a potential issue or as a confirmation/notification about an issue.

The use cases are also characterized based on the knowledge that is available at the time:

- ***Given damage***, the system is triggered based on damage (either real/observed or probable/predicted) to an asset of the area of interest.
- ***Given hazard***, the system is triggered based on a hazard (either real/observed or probable/predicted) that has materialized or can materialize at the area of interest.
- ***No given***, the system is triggered without any *additional input* of knowledge on the current status of the assets and/or hazards beyond what is already in place and it is expected to assess "all" potential scenarios of given damage or given hazard and combine them to provide a hierarchy of consequences based on the probabilities of them materializing.

The use cases are also identified based on the time frame for the implementation of the mitigation actions:

- ***Long term planning***, the mitigation actions provided by the system will be used to support the improvement of the resilience of the CH monuments based on budget availability and needs.
- ***Short term planning***, the mitigation actions provided by the system will be implemented as soon as possible aiming to limit the immediate consequences of a hazard.

According to the aforementioned classification, HYPERION will examine, implement and test a set of use cases, which will fully demonstrate the potential of the project outcomes. These use cases are outlined in table 1, where red cells correspond to short-term planning and green cells to long-term planning, and described in detail in the following paragraphs.

	No Given	Given Hazard	Given Damage
Pre-event	Use Case 1	Use Case 2	Use Case 3
Trans- event			Use Case 4
Post-event	Use Case 5		

Table 1: Summary of HYPERION use case scenarios

3.1 Pre-event

Use case 1: No givens, long-term planning

Scenario Description

At the end of each year the Ministry of Culture decides on budget allocation to regional authorities and reviews the long-term public sector investment plan.

Alex uses the HARP in order to have access to a map of the country presenting the deterioration risk of the building materials found in cultural heritage constructions under the influence of climate change. Within the map different colors represent different levels of deterioration. Higher budget for precautionary measures and rehabilitation work is allocated to the regions that are expected to face higher deterioration levels. The information presented on the map is derived from high accuracy hygrothermal simulations.

Moreover, Alex has access in the HRAP and can select the region in which he is interested. Based on this selection, he is presented with a hierarchy of risk prioritization as well as the expected consequences.

Due to Climate Change, the climate model predicts an important increase of winds in a specific area for the upcoming month. The structural model also knows that in this area two CH buildings are suffering from some yet-unrepaired damage due to an earthquake that took place earlier this year. Alex is made aware that these buildings are in immediate danger to collapse. He prioritizes the restoration works for these buildings, adding to the regional budget the needed money.

Next, he is accessing the Decision Support System, where he is presented with some long-term mitigation actions that will improve the resilience of the CH monuments of the region.

Knowing that his country is in a very active seismic zone, he is not surprised that there are areas affected by recent seismic activities that require some additional support to ensure that no structural problems will arise to buildings. He receives consulting on the financial risks involved in the event of the destruction of these monuments and he makes the needed adjustments to the public sector investment plan.

Rational

The rationale behind this use case is to showcase the usability of the HRAP platform, and the demonstration of certain system components that meet HYPERION's technical objectives, as these are shown in the following table.

Scenario Component	STO
Hygrothermal simulation tool	4
Risk Prediction	5
Environmental Prediction and Damage Diagnosis	6
HRAP UI – region selection	7
Risk Prioritization	7
DSS – Mitigation Actions	7
HRAP – Financial risk prediction	7

Use case 2: Given hazard intensity, short-term planning

Description

The Civil Protection agency has raised an alarm about extreme weather phenomena in an area. Rebecca is informed that the area will suffer from extreme rainfalls where the precipitation, in a short time range, is expected to be twice the amount of water usually reaching the area within the month.

Rebecca knows that this is a phenomenon never again encountered and she is worried about the possible issues that may occur. She is accessing HRAP, selects the region that she is interested in and initiates the targeted scenario. Through an easy-to-use interface she is adding the information that is available to her, namely expected rainfall and wind intensities as well as the time frame of the phenomena.

She receives a list with the possible risks prioritized, the expected consequences as well as immediate mitigation actions. She is now aware of the areas that will be the most affected by the upcoming phenomenon as well as the measures that should be taken to minimize the consequences.

Rational

The rationale behind this use case is to showcase the usability of the HRAP platform, and the demonstration of certain system components that meet HYPERION's technical objectives, as these are shown in the following table.

Scenario Component	STO
Hygrothermal simulation tool	4
Risk Prediction	5
Environmental Prediction and Damage Diagnosis	6
HRAP UI – region selection	7

Risk Prioritization	7
DSS – Mitigation Actions	7

Use case 3: Given damage, long term planning

Description

Due to recent political changes, there have been some threats for terrorist attacks to an area. While the government is not worried and has taken measures to protect the people from such threats, Mark is wondering what the consequences will be for the local economy in such a case.

Mark accesses HRAP and manually assigns damages to potential targets. The platform allows him to identify assets as completely destroyed or partially affected. After this characterization, he can see an estimation of the consequences to the local economy as well as a list of mitigation actions.

He communicates with Nick, to see what mitigation actions the utility companies are taking with regard to the potential danger, and with Nicole, to discuss alternative supply chains, stock availability and the proposed mitigation actions.

Based on these communications, he is taking the needed decisions to update his infrastructure and ensure the sustainability of his operations in the long term.

Rational

The rationale behind this use case is to showcase certain system components that meet HYPERION's technical objectives, as these are shown in the following table.

Scenario Component	STO
Multi-hazard modelling	2
HRAP UI – manually assign damages to targets	7
HRAP – Financial risk prediction	7
DSS – Mitigation Actions	7

3.2 Trans-event / Near real time

Use case 4: Given hazard, short-term planning

Description

Real time sensor data collected in the area of interest as well as public seismological information show that an earthquake took place.

HRAP examines the collected information, along with the characteristics of the area and the consequences identified by the models in such cases and notifies Martha if the earthquake has the potential to cause important issues.

Martha accesses the platform and is at once shown a map with flags where assets of the area and important CH building are flagged in an easy to identify way (green, yellow and red) based on the level of expected damage.

Martha is focusing of the red flags, dispatching units and field personnel to confirm the damages. She is also updating the system, confirming or correcting the flags as new information is made available to her.

In cases where the area is not easily accessible, too large to inspect with field personnel, or the level of damage is not easy to assess based on the collected information, Gloria is contacted to perform targeted UAV flights. Martha is shown the results of these flights as soon as they are available. Based on this additional information Martha concludes the confirmation or correction of the flags given by the models.

If damage is misclassified below an internal system threshold, an automated Bayesian updating process is triggered and the model is corrected based on the available information. If the damage misclassification is above this threshold, David is notified to proceed with a full retraining of the affected asset vulnerability models.

Given that the stability of structures has been ensured there are some additional risks that should be examined in more detail. For example, broken or leaking pipes may lead to high moisture content in building materials which can further lead to severe deterioration. Martha selects the best drying alternative (e.g. characteristics and operating time of dehumidifier) by examining different scenarios in the hygrothermal simulator. Moreover, based on the simulation results she defines the most appropriate retrofitting solution and the correct timing to employ it, considering that prior to rehabilitation work the building element should reach an equilibrium under the typical ambient conditions.

Rational

The rationale behind this use case is to showcase certain system components that meet HYPERION's technical objectives, as these are shown in the following table.

Scenario Component	STO
Reliable quantification of stressors using data from sensors	1
Reliable quantification of stressors using data from UAVs	1
Multi-hazard modelling	2
Model retraining and auto correction	2
Material deterioration modelling	3
Hygrothermal simulation tool	4
Material state identification and damage diagnosis	6
HRAP DSS – risk prioritization	7

3.3 Post-event

Use case 5: No given, Long term planning

Description

Donald is on his daily walk in the historical centre of his city. He notices a crack at a wall of a local CH building that he is certain it was not there the day before. He is very worried about the monument and potential structural hazards and he wants to report the problem.

He uses his phone, where he has already installed the Communities' Engagement ICT Tool, and takes a few photos. The photos are geo-tagged and time stamped. Donald adds a short description and a few additional information that he feels will be useful to the local authorities. He is also asked to provide a priority of the issue and a risk assessment for the monument and the people of the surrounding area. Donald decides that the crack is not of high priority and that the monument is not of immediate danger but he makes sure to note that the wall is adjacent to a park where kids are often playing in the evenings.

His report is forwarded to HRAP and Martha receives a notification. She is informed about the issue and she can review the problem.

She may choose to record the damages reported in the system if they are valid and not already included in the asset information database.

Donald's reporting may be associated with specific damage assessment if it is in close temporal and spatial proximity of an event or completely independent. Martha as the local authority is responsible to record the input received accordingly.

The change introduced in the asset information database triggers an automated updating of the asset vulnerability model, if it is below an internal system threshold. Otherwise, David is notified to proceed with a full retraining of the affected asset vulnerability hazard model.

Rational

The rationale behind this use case is to showcase certain system components that meet HYPERION's technical objectives, as these are shown in the following table.

Scenario Component	STO
HRAP – PLUGGY module	7
HRAP UI -	7

4. System Requirements

The starting point for setting the system requirements comes from deliverable D2.1, where User Needs have been identified thanks to previous activities such as Workshops and Desk Research activity. Some relevant parameters have been used for the User Requirements identification in order to provide all relevant information that are able to improve (and best describe) a specific User Requirement (e.g.: Unique ID, Classification, Data Need, Physical Material Need, Prioritization, etc.). The User Requirements are classified as Functional and Non-Functional. In this context, Functional requirements specify the system functionalities (what the system should be able to do) while Non-Functional requirements specify how the system should behave:

- **Functional**: specifies something that system should do (specific system functionality), thus services that the HYPERION system should provide (e.g.: how the innovation/system should react to particular inputs or how the system should behave in particular situations);
- **Non-Functional**: describes how the system works (performance, time, throughput, utilization, scalability, capacity, availability, reliability, security, regulatory, data integrity, interoperability, usability, etc.). In other words, constraints on the services or functions offered by the innovation/system (e.g.: timing constraints, constraints on the development process, standards, etc.).

Each User Requirement comes from the related Use Case Scenario and it is associated to the relevant system's technical objective. Namely, user requirements are described in the format shown in the following table.

Attribute	Description
Unique ID	The unique identifier used to reference this requirement
Type	Functional/ Non-functional
Priority	Must/Should/Could
Category	The name of the component that is responsible for implementing/meeting this requirement
Description	A short description explaining what the requirement is about
Justification	A short description explaining why this requirement is needed, referencing users' needs and use cases when applicable

Fit Criterion	A criterion, quantifiable when possible, explaining how the compliance to the requirement is going to be tested
Dependencies	Unique ids of other system requirements
Relevant WP/Task	The WP and specific tasks responsible to implement/comply with this requirement
Relevant Use Case Scenario	The use case scenario where this requirement is validated
Relevant STO	The project objective that this requirement derives from

4.1 Functional Requirements

The following set of functional requirements for the HYPERION system, as well as for its subsystems, were derived (a) from the GA, (b) from user needs described in deliverable D2.1, and (c) from extended discussions between end users and technical partners during the previous period.

Attribute	Description
Unique ID	FR_1
Type	Functional
Priority	Must
Category	General
Description	User authorization procedure
Justification	Restrict the use only to authorised personnel.
Fit Criterion	Unauthorized access declined
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_2
Type	Functional
Priority	Must
Category	General
Description	Map classification
Justification	Diverse strategies are followed for different Tiers.
Fit Criterion	Tier 1, Tier 2, Tier 3 buildings and areas are clearly identified per site
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_3
Type	Functional
Priority	Should
Category	General
Description	Types of threats monitored.
Justification	The HYPERION system focuses on a specific number of threats
Fit Criterion	The system can monitor the following types of threats: Earthquakes, floods, landslides, general weathering, freeze/thaw cycles, biological growth.
Dependencies	None

Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_4
Type	Functional
Priority	Could
Category	External Interfaces
Description	Data acquisition from external systems
Justification	A number of sensors are already installed in many CH sites.
Fit Criterion	System could be compatible to sensors providing structural monitoring (Inclinometers, Crack widths control, accelerometers), pollution monitoring (Air Quality), and climate/weather monitoring (Temperature, Humidity, Wind)
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_5
Type	Functional
Priority	Should
Category	Atmospheric Models

Description	Include all atmospheric parameters needed for the pilot areas
Justification	If any of the required atmospheric parameters are missing, then not all objectives will be met.
Fit Criterion	Include all atmospheric parameters needed for the pilot areas
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_6
Type	Functional
Priority	Should
Category	Atmospheric Models
Description	Provide the output in commonly accepted format
Justification	A commonly accepted format is needed in order to be able to feed the HRAP platform.
Fit Criterion	Provide the output in commonly accepted format
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_7

Type	Functional
Priority	Should
Category	Atmospheric Models
Description	Provide the output based on the agreed scenario and spatial resolution
Justification	Lower resolution data will not be able to meet the project objectives
Fit Criterion	Provide the output in resolution of 1*1 km^2
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_8
Type	Functional
Priority	Should
Category	Smart Tags
Description	Provide air temperature and humidity
Justification	Temperature and humidity readings are needed in order to calculate dew point information. They are also essential input for some of the core modelling components
Fit Criterion	Data from temperature and humidity sensors available
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_9
Type	Functional
Priority	Should
Category	Smart Tags
Description	Record measurements at least once per hour
Justification	Time resolution of measurements is derived taking into account wireless throughput and end user needs.
Fit Criterion	At least 24 sensor readings per day
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_10
Type	Functional
Priority	Should
Category	Smart Tags
Description	Push data daily to the backend
Justification	Data is stored locally in order to avoid unnecessary transmission costs and bandwidth use. Once a day all data is uploaded to the backbone.
Fit Criterion	Daily sensor readings are collected
Dependencies	None
Relevant WP/Task	WP3

Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_11
Type	Functional
Priority	Must
Category	Functions for the deterioration of building materials
Description	Function availability
Justification	In order for the HRAP platform to operate, functions for evaluating and predicting the deterioration of building materials must be available.
Fit Criterion	Provide the functions for all the pilot materials
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_12
Type	Functional
Priority	Must
Category	Functions for the deterioration of building materials
Description	Function Compatibility
Justification	In order for the HRAP platform to operate, functions for evaluating and

	predicting the deterioration of building materials must provide outputs that can be interpreted by the system.
Fit Criterion	Provide the functions in an integrable way
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_13
Type	Functional
Priority	Should
Category	Functions for the deterioration of building materials
Description	Function Dependency on Orientation
Justification	One of the key requirements for providing accurate estimates on the deterioration of monuments, is to take into account the dependability of deterioration to the monuments' orientation. Therefore, the functions predicting this deterioration should be taking into account the orientation of installed sensors and treat corresponding data accordingly
Fit Criterion	Provide deterioration functions based on building orientation
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_14
Type	Functional
Priority	Must
Category	Hygrothermal Simulator
Description	Simulator output compatibility
Justification	In order for the HRAP platform to operate, HT simulator output must be in a format that can be interpreted by the system.
Fit Criterion	Provide the output in commonly accepted format
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_15
Type	Functional
Priority	Could
Category	Hygrothermal Simulator
Description	Simulator Scenario
Justification	Users should be able to simulate the HT performance of various building materials under various climate change scenarios.
Fit Criterion	The simulator should incorporate the properties of the materials found in the pilot areas and high-resolution climate files for past and potential future years.

Dependencies	FR_4
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_16
Type	Functional
Priority	Must
Category	Hygrothermal Simulator
Description	HT Simulator online availability
Justification	In order to enhance user acceptance, the interface to the HT simulator should be implemented through a webpage accessible to all authorized users.
Fit Criterion	Provide an open-access tool and a webpage that will allow role-based access to the database created
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_17
Type	Functional
Priority	Could
Category	Hygrothermal Simulator

Description	Assessment of building material deterioration.
Justification	Users should get quantitative results describing the damage on the building materials under various scenarios.
Fit Criterion	The transient HT conditions calculated by the simulation tool can be used as an input in damage functions.
Dependencies	FR_08
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_18
Type	Functional
Priority	Must
Category	Multi-hazard Model
Description	Multi-hazard Model compatibility
Justification	In order for the HRAP platform to operate, the output of the Multi-hazard Model must be in a format that can be interpreted by the system.
Fit Criterion	Provide the output in commonly accepted format
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_19
Type	Functional
Priority	Must
Category	Multi-hazard Model
Description	Multi-hazard Model Spatial Resolution
Justification	Lower resolution data will not be able to meet the project objectives
Fit Criterion	Provide the output based on the agreed scenario and spatial resolution of 1km^2
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_20
Type	Functional
Priority	Must
Category	Multi-hazard Model
Description	Multi-hazard Model output integration with atmospheric models
Justification	Multi-hazard models must include information about all hazards
Fit Criterion	Integrate the output from the atmospheric models
Dependencies	None
Relevant WP/Task	WP5 & WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_21
Type	Functional
Priority	Could
Category	Structural & Geotechnical Simulator
Description	Simulator Scenario
Justification	Users could be able to simulate the SG performance of various buildings subjected to different risk scenarios
Fit Criterion	The simulator should incorporate the structural system and configuration, properties of the materials found in the pilot areas and multi risk files for past and potential future years
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_22
Type	Functional
Priority	Must
Category	Structural Geotechnical Simulator
Description	SG Simulator online availability
Justification	In order to enhance user acceptance, the interface to the SG simulator should be implemented through a webpage accessible to all authorized users

Fit Criterion	Provide an open-access tool and a webpage that will allow, role-based access to the database created
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_23
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	Download material properties data
Justification	The user should be able to download the material properties data produced as well as the deterioration prediction function
Fit Criterion	JSON files containing material properties data downloaded and stored locally
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_24
Type	Functional

Priority	Should
Category	Vulnerability Modules
Description	VM transient measured data
Justification	The user should be able to download the transient measured data from the sensors installed in the test cubes.
Fit Criterion	Transient measured data are in a commonly accepted format
Dependencies	None
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_25
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	VM Hazard Models Input
Justification	The user should be able to download the hazard models and tools generated for the project sites.
Fit Criterion	Hazard Models output is in a commonly accepted format
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description

Unique ID	FR_26
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	VM Raw Climate data
Justification	The user should be able to download the raw climate data generated for the project sites for both past and potential future year.
Fit Criterion	Raw Climate data are in a commonly accepted format
Dependencies	WP5, Task T5.1
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_27
Type	Functional
Priority	Could
Category	Vulnerability Modules
Description	VM 3D images and documentations
Justification	The user could be able to download the 3D images and documentation of files of the Trier 1 and 2 buildings
Fit Criterion	3D images files are in a commonly accepted format
Dependencies	FR_33 & FR_34
Relevant WP/Task	WP6
Relevant Use Case Scenario	All

Relevant STO	All

Attribute	Description
Unique ID	FR_28
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	VM Weather Stations data input
Justification	The user should be able to download the measurements of the weather stations installed in the pilot areas.
Fit Criterion	Weather station data are in a commonly accepted format
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_29
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	VM 3D scanned file input
Justification	The user should be able to download the 3D-scanned files of the Trier 1 and 2 buildings.
Fit Criterion	3D-scanned files are in a commonly accepted format

Dependencies	WP6
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_30
Type	Functional
Priority	Should
Category	Vulnerability Modules
Description	VM Local Processing
Justification	The user should be able to process the input data in his PC in order to produce the new files that will serve as inputs for the Structural-Geotechnical simulator.
Fit Criterion	User is able to upload, delete and modify the new climate and hazard intensity files; the new files containing material properties; reports describing the processing and utility of data;
Dependencies	FR_25, FR_26, FR_27, FR_28, FR_29, FR_30, FR_31
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_31
Type	Functional
Priority	Should
Category	Resilience Assessment Framework

Description	Resilience Assessment Framework compatibility
Justification	In order for the HRAP platform to operate, the output of the resilience assessment framework must be in a format that can be interpreted by the system.
Fit Criterion	Provide the output in commonly accepted format
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_32
Type	Functional
Priority	Should
Category	Resilience Assessment Framework
Description	Resilience Assessment Framework compatibility
Justification	In order for the output to be integrable with the other models it should respect the agreed scenario
Fit Criterion	Provide the output based on the agreed scenario
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_33
Type	Functional
Priority	Must
Category	Resilience Assessment Framework
Description	Resilience Assessment Framework compatibility
Justification	Lower resolution data will not be able to meet the project objectives
Fit Criterion	Provide the output based on the agreed scenario and spatial resolution of 1*1km^2
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_34
Type	Functional
Priority	Should
Category	Socioeconomic Resilience Engine
Description	Socioeconomic Resilience engine data harvesting
Justification	There is a need to map the local needs of each pilot case. Targeted surveys to business owners and other parties will provide the needed insight
Fit Criterion	Collect information by carrying out targeted surveys
Dependencies	None

Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_35
Type	Functional
Priority	Should
Category	Socioeconomic Resilience Engine
Description	Create a socioeconomic model for users, local economy and small businesses.
Justification	The model should include all aspects of the local economy
Fit Criterion	The model properly depicts the local economy
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_36
Type	Functional
Priority	Should
Category	Socioeconomic Resilience Engine
Description	Socioeconomic Resilience Engine compatibility
Justification	The engine should be integrable to the overall system

Fit Criterion	Provide the output in commonly accepted format
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_37
Type	Functional
Priority	Should
Category	Socioeconomic Resilience Engine
Description	Socioeconomic Resilience Engine output
Justification	The engine should be integrable to the overall system
Fit Criterion	Provide querying capabilities based on given hazard
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_38
Type	Functional
Priority	Must
Category	UAS
Description	The UAS is necessary for each Tier 1 building/site in order to immediately acquire the appropriate data for the 3D

	documentation in case of an event or in a routine monitoring context
Justification	Create a system containing an aerial vehicle, an autonomous or human-operated control system and a command and control system for it so that it can be deployed in all pilots in case of an event
Fit Criterion	Provide the necessary data in an accepted format in order to further process them
Dependencies	None
Relevant WP/Task	WP6
Relevant Use Case Scenario	1 & 4
Relevant STO	All

Attribute	Description
Unique ID	FR_39
Type	Functional
Priority	Could
Category	UAS
Description	The UAS raw data (digital images) could be uploaded in HRAP in order to make them available to all the users in case of an event or in a routine monitoring
Justification	The aerial digital images can be extremely useful to all the users of HRAP in order to closely examine the Tier 1 CH buildings/sites in case of an event or in a routine monitoring and detect/extract more information
Fit Criterion	Provide the necessary data in an accepted format in order to further process them
Dependencies	None

Relevant WP/Task	WP6
Relevant Use Case Scenario	1, 4 & 5
Relevant STO	All

Attribute	Description
Unique ID	FR_40
Type	Functional
Priority	Must
Category	Monitoring capabilities
Description	In a routine monitoring context, each Tier 1 building/site will be 3D documented and reference 3D models will be created. A methodology will be developed for the estimation of the deformations in a regular monitoring framework. A similar methodology will be developed for the estimation of changes in building materials from hyperspectral imagery.
Justification	Reference 3D models of the buildings and methodology for 3D model comparison in time. Also, a methodology for comparison of hyperspectral signature of materials in time.
Fit Criterion	Level of Detail and/or accuracy
Dependencies	None
Relevant WP/Task	WP6
Relevant Use Case Scenario	1, 4 & 5
Relevant STO	All

Attribute	Description
Unique ID	FR_41

Type	Functional
Priority	Must
Category	Monitoring capabilities
Description	Establishment of a standard monitoring procedures including selection, downloading, pre-processing, and processing of satellite images for Tier 3 information on Hyperion areas in order to regularly estimate land deformation and land use changes in these areas
Justification	Identify hazards with slow or gradual onset (e.g. subsidence) and define the risk factors that have the potential to cause damage (e.g. increase of the impervious surfaces around the historic area)
Fit Criterion	Provide the necessary products in an accepted format in order to be linked with other system components into a dynamic hazard and resilience assessment.
Dependencies	None
Relevant WP/Task	WP6
Relevant Use Case Scenario	1, 2 & 5
Relevant STO	All

Attribute	Description
Unique ID	FR_42
Type	Functional
Priority	Must
Category	Damage Assessment
Description	After the acquisition process of the UAS, the data will be processed in the GGS and the accurate, detailed 3D models will be produced and stored in HRAP.

	Furthermore, satellite remote sensing data will be processed in the GGS which will provide Tier 3 pre- and post-disaster products related to landslide, earthquake or flood events Hyperspectral imagery information will be processed and analysed in the GGS to derive information regarding potential damage on sites materials.
Justification	The 3D models will be used to provide information about the status of the geometry of each building and any kind of deformation in case of an event. Satellite remote sensing products will provide information about the impact of the disaster in the broader area. Hyperspectral related products will provide insight about the potential damage on the sites.
Fit Criterion	Level of Detail and/or accuracy
Dependencies	None
Relevant WP/Task	WP6
Relevant Use Case Scenario	1, 2 & 4
Relevant STO	All

Attribute	Description
Unique ID	FR_43
Type	Functional
Priority	Should
Category	HRAP Platform
Description	Keep track of all users' activities.
Justification	For the users who have privileged access to the HRAP and Modules with sensitive

	information, auditing helps ensure accountability and improve regulatory compliance.
Fit Criterion	Log user activity
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_44
Type	Functional
Priority	Should
Category	HRAP Platform
Description	A User-friendly and intelligent user interface to visualize all the user activities
Justification	Engage the user and support the discovery of information
Fit Criterion	Visualize user activity logs
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_45
Type	Functional
Priority	Should
Category	HRAP Platform

Description	The ability for administrators to manage user access to the HRAP
Justification	Support the user management
Fit Criterion	User management (create/ delete/ update)
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_46
Type	Functional
Priority	Should
Category	HRAP Platform
Description	A policy-neutral access-control mechanism defined around roles and privileges
Justification	Ensure that each user will have access to the role relevant data and modules.
Fit Criterion	User roles (access based on the role)
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_47
Type	Functional
Priority	Should

Category	HRAP Platform
Description	Provide the ability to the users to perform spatial queries over the data
Justification	Users are interested in the spatial aspect of the information
Fit Criterion	Spatial querying over all models
Dependencies	All
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_48
Type	Functional
Priority	Should
Category	HRAP Platform
Description	The user interface design will make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals
Justification	Platform should be usable by the unexperienced user with minimal training
Fit Criterion	User friendly interface
Dependencies	All
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description

Unique ID	FR_49
Type	Functional
Priority	Should
Category	HRAP Platform
Description	Personalized views, according to user roles.
Justification	Not all data and modules are needed to all roles. Therefore, user view should be role dependent in order to increase user acceptance and usability.
Fit Criterion	Personal profile, options, favourites stored
Dependencies	None
Relevant WP/Task	Wp7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_50
Type	Functional
Priority	Should
Category	HRAP Platform
Description	HRAP Platform Visualization
Justification	Overlay relevant information
Fit Criterion	Visualization of models, either together or independently
Dependencies	WP5, WP6
Relevant WP/Task	WP7
Relevant Use Case Scenario	ALL
Relevant STO	ALL

Attribute	Description
Unique ID	FR_51
Type	Functional
Priority	Should
Category	HRAP Platform
Description	The HRAP Platform will visualize BIM models
Justification	End users need to see a 3D representation of Tier 1 buildings
Fit Criterion	Support the visualization of the 3D models for the buildings
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	ALL
Relevant STO	ALL

Attribute	Description
Unique ID	FR_52
Type	Functional
Priority	Should
Category	HRAP Platform
Description	DSS will provide assistance to the CH operators during maintenance as well as all phases of a crisis incident (mitigation, preparedness, response and recovery).
Justification	End users need to be provided with a number of recommended actions.
Fit Criterion	Create a DSS that will provide the users with mitigation actions
Dependencies	WP5.6

Relevant WP/Task	WP7.2
Relevant Use Case Scenario	ALL
Relevant STO	ALL

Attribute	Description
Unique ID	FR_53
Type	Functional
Priority	Should
Category	HRAP Platform
Description	Assessing Business Continuity Models and Adaptation Strategies
Justification	Validation of economic impact of hazards on the local communities is a key user need.
Fit Criterion	Allow the user to validate the categorization of the models after given hazard
Dependencies	WP4, WP5, WP6
Relevant WP/Task	WP7.5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_54
Type	Functional
Priority	Should
Category	HRAP Platform
Description	Visualisation interface will provide assistance to the CH operators during maintenance as well as all phases of a

	crisis incident (mitigation, preparedness, response and recovery).
Justification	Platform should be easy to use for a large range of inexperienced users with minimal training
Fit Criterion	Visualize information provided by the users of the ICT tool
Dependencies	WP4,WP5,WP6
Relevant WP/Task	WP7.5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_55
Type	Functional
Priority	Could
Category	HRAP Platform
Description	Provide weighted mitigation strategies
Justification	Be able to prioritize actions
Fit Criterion	Mitigation strategies are listed according to their cost function, which takes into account cost and probability of success.
Dependencies	WP4,WP5,WP6
Relevant WP/Task	WP7.5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_56

Type	Functional
Priority	Should
Category	Business Continuity Models
Description	The models should provide the needed information to the DSS
Justification	Suggestions and mitigation actions proposed must be justifiable
Fit Criterion	Provide the needed information for the DSS
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_57
Type	Functional
Priority	Should
Category	Business Continuity Models
Description	The model output needs to be in compliance with the other models so as to be integrable
Justification	The HRAP platform should receive the information in a uniform way
Fit Criterion	Provide the output in an easily integrable format
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_58
Type	Functional
Priority	Should
Category	Business Continuity Models
Description	The model output needs to be in compliance with the other models so as to be integrable
Justification	The HRAP platform needs the models to be queryable
Fit Criterion	Provide querying capabilities based on given hazard and damage
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_59
Type	Functional
Priority	Should
Category	Response Actions
Description	The models should provide the needed information to the DSS
Justification	Suggestions and mitigation actions proposed must be justifiable
Fit Criterion	Provide the needed information for the DSS
Dependencies	None
Relevant WP/Task	WP7

Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_60
Type	Functional
Priority	Should
Category	Response Actions
Description	The model output needs to be in compliance with the other models so as to be integrable
Justification	The HRAP platform should receive the information in a uniform way
Fit Criterion	Provide the output in an easily integrable format
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_61
Type	Functional
Priority	Must
Category	Middleware
Description	Middleware must be able to collect data from various sensors/smart tags in real time.

Justification	The middleware acts as a proxy between the external world data and the rest of the system. This module is the starting point for data collection. It must be versatile enough to accommodate for different modes of collection.
Fit Criterion	Support the communication between the smart tags and the backend. Any sensors or edge component that is outside the middleware realm and PUSHes data towards the middleware will have to comply to a standardised protocol that is issued by the system.
Dependencies	FR_7
Relevant WP/Task	WP7
Relevant Use Case Scenario	4
Relevant STO	All

Attribute	Description
Unique ID	FR_62
Type	Functional
Priority	Should
Category	Middleware
Description	Middleware must be able to collect and store data from various available datasets, i.e. seismological information, or user uploaded.
Justification	The middleware acts as a proxy between the external world data and the rest of the system. This module is the starting point for data collection. It must be versatile enough to accommodate for different modes of collection

Fit Criterion	Support the communication between the smart tags and other data sources and the backend
Dependencies	External data sources are made available to PULL data from or adjusted to PUSH into the module FR_7
Relevant WP/Task	WP7
Relevant Use Case Scenario	4
Relevant STO	All

Attribute	Description
Unique ID	FR_63
Type	Functional
Priority	Should
Category	Middleware
Description	The Middleware should be able to accept, store and retrieve input from HRAP if this is deemed necessary by the HRAP processes. The input should be relevant to open user sessions and model outputs.
Justification	Middleware should be able to store the model outputs and make them available to HRAP.
Fit Criterion	Support the storage of the outputs of the models
Dependencies	FR_3 FR_15
Relevant WP/Task	WP 7
Relevant Use Case Scenario	4
Relevant STO	All

Attribute	Description
Unique ID	FR_64
Type	Functional
Priority	Should
Category	Middleware
Description	Models are updated (offline) based on new input. Thus, results stored in the middleware must also be updated.
Justification	HRAP should have access to model outputs.
Fit Criterion	Support the retrieval/update of the models
Dependencies	FR_64
Relevant WP/Task	WP 7
Relevant Use Case Scenario	4
Relevant STO	All

Attribute	Description
Unique ID	FR_65
Type	Functional
Priority	Must
Category	Middleware
Description	Middleware must expose an API to enable HRAP access the collected data and the model results.
Justification	A persistent secure connection is needed to connect the two distinct parts of the platform so that bidirectional communication is established for the exchange of data and information. Relevant APIs encapsulating each defined call will be created.

Fit Criterion	Support the communication between HRAP and middleware
Dependencies	HRAP must be able to pull data from the middleware
Relevant WP/Task	WP7
Relevant Use Case Scenario	4
Relevant STO	All

Attribute	Description
Unique ID	FR_66
Type	Functional
Priority	Should
Category	ICT Tool
Description	The images collected by the user should include information about the location that they were captured and the time
Justification	Information without time and space is not useful for the validation of the models
Fit Criterion	Provide geotagged and time-stamped images
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_67
Type	Functional
Priority	Should

Category	ICT Tool
Description	The ICT Tool should allow the creation of new user, manage user profiles and passwords
Justification	The ICT Tool addresses citizens so it needs to have different users than the HRAP platform
Fit Criterion	Provide user management
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	FR_68
Type	Functional
Priority	Should
Category	ICT Tools
Description	The ICT Tool addresses citizens so it needs to be as engaging as possible
Justification	Crowd sourcing information can be a challenge, user friendliness should be heavily considered
Fit Criterion	Provide user friendly interface, both web and mobile
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description

Unique ID	FR_69
Type	Functional
Priority	Should
Category	ICT Tools
Description	The information collected should be available at the HRAP platform
Justification	The images and reports collected are crucial for the validation of the models
Fit Criterion	Make available the collected information to the HRAP
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

4.2 Non-Functional Requirements

The following set of non-functional requirements for the HYPERION system, as well as for its subsystems, were derived (a) from the GA, (b) from user needs described in deliverable D2.1, and (c) from extended discussions between end users and technical partners during the previous period.

Attribute	Description
Unique ID	NFR_1
Type	Non-Functional
Priority	Must
Category	General
Description	Data Storage
Justification	Store all data/metadata needed for the calculation of the KPIs
Fit Criterion	Store all data/metadata needed for the calculation of the KPIs
Dependencies	None

Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_2
Type	Non-Functional
Priority	Must
Category	General
Description	Keep code versioning
Justification	Be able to retrieve previous working code
Fit Criterion	All code versions are available on the ICCS cloud
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_3
Type	Non-Functional
Priority	Must
Category	General
Description	National and EU regulations compliance
Justification	Compliance
Fit Criterion	Compliant with National and EU regulations (including GDPR)
Dependencies	None

Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_4
Type	Non-Functional
Priority	Should
Category	Atmospheric Models
Description	Continuous update based on the data collected from the micro-climatic stations
Justification	Calibrating the atmospheric models with local measurement data is important for guaranteeing realistic model simulations
Fit Criterion	Models are capable of effectively taking into account the available measurement
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_5
Type	Non-Functional
Priority	Must
Category	Smart Tags
Description	Smart Tag Installation
Justification	Installation of smart tags should not cause any damage to the monuments.

Fit Criterion	Tags are installed without causing damage or being intrusive to the monument
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_6
Type	Non-Functional
Priority	Could
Category	Smart Tags
Description	Smart Tag Autonomy
Justification	In many monuments there is no power available, nor WiFi connections. The smart tags should be able to operate for a period of several days without the need for changing batteries. Moreover, smart tags could rely on other terrestrial communication media than WiFi.
Fit Criterion	Work with the available infrastructure at the Tier 1 buildings, including lack of power and/or WiFi for 3 months
Dependencies	None
Relevant WP/Task	WP3
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_7

Type	Non-Functional
Priority	Must
Category	Hygrothermal Simulator
Description	Simulator input climate data
Justification	Users will have credible results from the HT simulator only if the input climate files have high resolution and cover a wide variety of potential future scenarios.
Fit Criterion	Integrate the output from the atmospheric models.
Dependencies	FR_04
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_8
Type	Non-Functional
Priority	Must
Category	Hygrothermal Simulator
Description	Simulator input material properties
Justification	Users will have credible results from the HT simulator only if the input material properties are accurate.
Fit Criterion	Integrate the output from the material properties tests.
Dependencies	NFR_20, FR_8, FR_9, FR_20
Relevant WP/Task	WP4
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_9
Type	Non-Functional
Priority	Should
Category	Resilience Assessment Framework
Description	Resilience Assessment Framework model integration
Justification	The Resilience Assessment framework is capable of integrating the hazard and vulnerability models into a single framework that will enable the DSS to provide a holistic view of the situation to end users
Fit Criterion	Integrate the hazard and vulnerability models into the Resilience Assessment Framework
Dependencies	All NFRs related to Multi-Hazard Models and Vulnerability Modules
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_10
Type	Non-Functional
Priority	Must
Category	Structural Geotechnical Simulator
Description	Simulator input hazard intensity

Justification	Users will have credible results from the SG simulator only if the input hazard intensity files have high resolution and cover a wide variety of potential future scenarios
Fit Criterion	Integrate the output from the atmospheric models
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_11
Type	Non-Functional
Priority	Must
Category	Structural Geotechnical Simulator
Description	Simulator input material properties
Justification	Users will have credible results from the SG simulator only if the input material properties are accurate
Fit Criterion	Integrate the output from the material properties tests.
Dependencies	NFR_20, FR_8, FR_9, FR_20
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_12
Type	Non-Functional

Priority	Must
Category	Structural Geotechnical Simulator
Description	Simulator input 3D drawings
Justification	Users will have credible results from the SG simulator only if the input 3D drawing files have high resolution and cover a wide variety of potential future scenarios
Fit Criterion	Integrate the output from the atmospheric models
Dependencies	None
Relevant WP/Task	WP5
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_13
Type	Non-Functional
Priority	Should
Category	HRAP Platform
Description	Transfer of data such as confidential or proprietary information over a secure channel.
Justification	Secure all communications between the HRAP and the other modules
Fit Criterion	Supports encrypted transmission (SSL, TLS, SSH, VPN etc.)
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All

Relevant STO	All

Attribute	Description
Unique ID	NFR_14
Type	Non-Functional
Priority	Should
Category	HRAP Platform
Description	Storage encryption is a technology which protects information by converting it into unreadable code that cannot be deciphered easily by unauthorized people.
Justification	Secure all date stored in HRAP
Fit Criterion	Supports encrypted storage (TDE, EFS etc.)
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_15
Type	Non-Functional
Priority	Should
Category	Middleware
Description	Object Virtualisation Module – A module that is used to virtualize data collected from smart tags and other sensors under a single queryable object.

Justification	Data virtualization facilitates the data storage and transfer among various components
Fit Criterion	Supports object virtualization
Dependencies	FR_60
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_16
Type	Non-Functional
Priority	Should
Category	Middleware/Event Queries Manager
Description	The Event Queries Manager is set to query and extract possible events from the collected data and model outputs. These events are then passed to the Event Queue for further processing to detect and raise complex alerts
Justification	When data is collected or captured, an event pre-processing logic is applied to identify potential system alerts. The Event Query manager reacts to new data by applying standardised queries and if events are identified then they are queued for handling
Fit Criterion	Data pre-processing and event processing activities
Dependencies	New data collections enter the system
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_17
Type	Non-Functional
Priority	Should
Category	Middleware/Event Queries Manager
Description	The Event Handling Manager processes identified events, by applying pre-set event handling and reasoning rules. The Manager also applies Complex Event Processing (CEP) to identify potential actions stemming from multiple events and not just single units.
Justification	Event Handling is applied on queued events to create alerts and notifications and also provide the DSS with additional processing input if necessary
Fit Criterion	Data pre-processing and event processing activities
Dependencies	• Queued events are available. • Event Handling and Reasoning Rules are provided by the scientific partners so that events can be isolated and identified.
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_18
Type	Non-Functional
Priority	Should
Category	Middleware

Description	Alert Module – A module that is used to raise and log alerts based on model outputs and smart tags/sensors collected data.
Justification	An alert should be raised based on collected data to inform stakeholders for potential risks and/or damages
Fit Criterion	Supports alerts based on collected data
Dependencies	NFR_13 NFR_14
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_19
Type	Non-Functional
Priority	Should
Category	HRAP Platform
Description	Projection Timeframe
Justification	The Greek national adaptation strategy adopted in 2016 has a 10-year time horizon and outlines broad policy directions and adaptation actions in vulnerable sectors.
Fit Criterion	HRAP should be able to provide projections for at least 10 years forward.
Dependencies	None
Relevant WP/Task	WP7
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_20
Type	Non-Functional
Priority	Must
Category	General
Description	Types of materials characterised
Justification	Materials used in monitored CH sites must be characterised for the models to work.
Fit Criterion	Mechanical properties of the following materials must be deducted: Porous Limestone, Sandy Limestone, Mountain Limestone, Wood, Metal, Rammed Earth, Brick, Mortar, Quaternary Conglomerate, Marble, Plaster, Granite and Porphyry
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

Attribute	Description
Unique ID	NFR_21
Type	Non-Functional
Priority	Must
Category	Smart Tags
Description	Types of smart tag sensors
Justification	Smart tag sensors should be cost effective and provide enough information for the models

Fit Criterion	Smart Tags will integrate relative humidity and temperature sensors
Dependencies	None
Relevant WP/Task	All
Relevant Use Case Scenario	All
Relevant STO	All

5. Pilot specific scenario

In this section we take a step forward from the definition of the use case scenarios, to study the exact premises where the validation and demonstration of the HYPERION system and subsystem components will be conducted. A number of specific venues have already been identified in each test site, namely Venice, Granada, Rhodes and Tonsberg. These venues have been evaluated against a number of characteristics relevant to the deployment of the HYPERION system, such as accessibility, internet connectivity, presence of a powerline network, and a comprehensive study has been made to identify any forthcoming challenges related to the installation of sensory systems. Once these have been identified, we were able to assign venues to specific use case scenarios, and pin point any specific issues and hazards that may arise during the deployment phase.

5.1 Study of the pilot premises

Venice

Building: Torre dell'Orologio

Address: Piazza San Marco - Venezia

Accessibility: the upper floors of the tower are reachable only through a narrow spiral staircase

Connectivity: there is no dedicated Internet connection in the building but a local public Wi-Fi network is accessible (for free for citizens and workers and for a small fee for tourists)

Power supply: available on each floor

Restrictions for equipment: due to the small size of the rooms of the building and the presence inside of delicate and fine artefacts (the gears and sculptures of the clock) only limited areas of the building are completely accessible to the materials and equipment of the project. The spaces for the cube, which includes stones samples, sensors, control unit, and the climatic station are already defined (the end area of the

side terrace towards the Basilica and/or the Mori terrace in case of extreme need) and cannot be increased.

Restrictions for mounting material: Assembly and testing of the cube and climatic station must be carried out by 11 am, as tourist tours are scheduled from that time. The cube and the climatic station must not be fixed in any way with anchor screws and cannot protrude beyond the balustrade. During the monitoring process, the presence of a staff member of the CVI or of the "Fondazione Musei Civici" (authority responsible for managing the building) is required.

General restrictions/limitations: No storage space available. As with the assembly procedure, any other visits to the monument linked to the project must be made before 11 am and under the supervision of a staff member.

Tønsberg

Building: The Heierstad Loft

Address: Farmannsveien 30, 3111 Tønsberg

Accessibility: The building is part of an open-air museum. It is accessible on foot, but can be accessed by car with special permission from owner to carry equipment etc.

Connectivity: 4G+ cellular network

Power supply: No

Restrictions for equipment: No

Restrictions for mounting material: No

General restrictions/limitations: The building is subject to The Cultural Heritage Act (1978). All measures and any changes to the building shall be approved by the authorities. Authority: VTFK (regional).

Building: The Fadum storehouse

Address: Farmannsveien 30, 3111 Tønsberg

Accessibility: The building is part of an open-air museum. It is accessible on foot, but can be accessed by car with special permission from owner to carry equipment etc.

Connectivity: 4G+ cellular network

Power supply: Yes

Restrictions for equipment: No

Restrictions for mounting material: No

General restrictions/limitations: The building I subject to The Act of 27 June 2008 No. 71 relating to Planning and the Processing of Building Applications. Authority: Municipality of Tønsberg (local).

Building: The Western Tower

Address: Farmannsveien 30, 3111 Tønsberg

Accessibility: The building (ruin) is part of an open, public area. It is only accessible on foot (ca. 100 m to walk from car).

Connectivity: 4G+ cellular network

Power supply: No

Restrictions for equipment: No

Restrictions for mounting material: No

General restrictions/limitations: The building is subject to The Cultural Heritage Act (1978). All measures and any changes to the ruin shall be approved by the authorities. Authority: The Directorate for Cultural Heritage (national).

Building: Bentegården

Address: Nordbyen 16, 3111 Tønsberg

Accessibility: The building is a private residence. Permission from owner necessary to get access inside. The building is accessible with car.

Connectivity: 4G cellular network

Power supply: Yes

Restrictions for equipment: No

Restrictions for mounting material: No

General restrictions/limitations: The building is subject to The Cultural Heritage Act (1978). All measures and any changes to the building shall be approved by the authorities. Authority: VTFK (regional).

Rhodes

Building: Saint Nikolas lighthouse and fort

Address: Mantraki port

Accessibility: The upper floors of the lighthouse are reachable through a narrow staircase

Connectivity: There is no dedicated Internet connection

Power supply: Available

Restrictions for equipment: The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative. Precaution should be taken so that no damage will be caused on the vulnerable parts of the monument.

Restrictions for mounting material: The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative. Precaution should be taken so that no damage will be caused on the vulnerable parts of the monument.

General restrictions/limitations: The monument is not accessible to the public. Limited access can be granted under specific circumstances.

Building: Nailac Pier

Address: Mantraki port

Accessibility: Not easily accessible

Connectivity: There is no dedicated Internet connection

Power supply: Not available

Restrictions for equipment: The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative. Precaution should be taken so that no damage will be caused on the vulnerable parts of the monument.

Restrictions for mounting material: The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative. Precaution should be taken so that no damage will be caused on the vulnerable parts of the monument.

General restrictions/limitations: The monument is not accessible to the public. Limited access can be granted under specific circumstances.

Building: Grave complex in Rhodini

Address: Rhodes town, Rhodini park

Accessibility: Accessible by car and a few minutes' walk. The place is open to the public without any restriction.

Connectivity: There is no dedicated Internet connection

Power supply: Not available

Restrictions for equipment: The grave complex does not belong to an organised archaeological site and has a free access to the public. The area is isolated and therefore protection measures (for example fencing of the area) should be taken in order to avoid damages on the equipment by individuals.

The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative.

Restrictions for mounting material: Precaution should be taken so that no damage will be caused on the vulnerable parts of the monument; for that reason the exact place upon which the relevant material will be mount should be indicated by the EFAD.

General restrictions/limitations: The monument has a free access to the public.

Building: Roman bridge

Address: Rhodes town

Accessibility: The archaeological site is enclosed by a fence. Access is authorised by the EFAD

Connectivity: There is no dedicated Internet connection

Power supply: Not available

Restrictions for equipment: The placement and mounting of any equipment needs to be approved by the Central Archaeological Council and the installation will be executed with the presence and under the supervision of an EFAD representative.

The upper part of the bridge is a high traffic road of the modern city.

The bed of the stream into which the equipment will be placed is constantly filled with dense vegetation and a clearing of the site by mechanical means will be necessary.

Restrictions for mounting material: The exact points on which the material will be mount will be indicated by the EFAD, so that no damages will be caused on the monument.

General restrictions/limitations: The area is not open to the public, is enclosed in a fence, and it is accessible only by the permission of the EFAD.

Granada

Building: San Jerónimo Monastery

Address: Calle Rector López Argüeta 9, Granada

Accessibility: The church has no accessibility problems. However, the upper floors of the tower are reachable through a narrow staircase.

Connectivity: There is not internet connection in the monastery. However, a mobile data network connection will be set up.

Power supply: Available in some parts of the building. Electrical extension cords will be probably needed.

Restrictions for equipment: The church and the tower have plenty of space available to install the accelerometers and the climate station. Notwithstanding, a likely restriction is the mobile phone coverage.

Restrictions for mounting material: The sensors need to be inserted within the stones of the monastery, which means that small diameter holes will need to be drilled in some walls.

General restrictions/limitations: Worktime on site is restricted to the availability of the Monastery keeper.

5.2 Specific hazards & scenario

Venice

Use cases 1, 2 and 5 can fit well with Venice. Of particular interest are flooding events from a combination of tide, southern wind and/or heavy precipitation. Long-term pre-event predictions as well as short-term given hazard assessments are of particular interest to help prepare for mitigating water damage to CH and non-CH assets.

Tønsberg

Most buildings in the pilot area are purely timber, while there are a few constructions made of stone. The main degradation factors of the timber buildings are biodeterioration (i.e. fungal, insect and lichen attack) and weathering. On the other hand, the structures that are made of stone are mainly degraded due to freeze and thaw cycles. Thus, it is important to examine these specific materials and deterioration mechanisms under current and potential future conditions. For the aims of the investigation hygrothermal simulations should be employed using as an input accurate material properties (physical, thermal, hygric), high-resolution (spatial:1x1 km and time:1 h) climate data and boundary conditions defined in CFD models. Resulting transient hygrothermal conditions will then serve as an input in damage functions of mould growth, insect attack, freeze-thaw damage. The above-mentioned damages can also be studied under extreme events such as incidents of high precipitation or unprecedented warm and wet winters.

Apart from the building materials, freeze-thaw cycles also affect the rock material of the cliffs and may cause rockfall and subsequently destruction of parts of Nordbyen. Thus, damage function of freeze-thaw may be used for the ground material, as well.

The location of Nordbyen and Bentegården is directly at the coastline of the fjord as well as at the foot of the steep cliffs of the Slottsfjellet. This makes it prone to flooding caused by either storm surges and/or surface runoff from the cliffs. Thus, the consequences of extreme rainfall events may be examined in more detail for this specific area.

The pilot area is well known for both its historic value and the large festivals and events that take place during the summer period. If the cultural heritage site ever gets partly destroyed by vandalism and needs to remain closed for an extended period of time, it will certainly induce catastrophic economic consequences to the local society. Thus, a more detailed analysis should be employed in order to provide quantifiable results.

Use cases 1, 2 and 4 fit well to the Tønsberg pilot area.

Rhodes

Use cases 1-4 are ideal for the needs of Rhodes. Two scenarios of earthquake and storm damage can be identified as particularly relevant, the first directly damaging CH and non-CH assets, while the second being a threat mostly for public utilities and related infrastructure throughout the island.

Granada

Use cases 1-4 are a good fit for the needs of Granada. Earthquake and heavy precipitation scenarios are potential top stressors for the city in the future. Even small earthquakes can have large consequences in a city that is largely unprepared for them, while there is non-negligible potential for water damage in the historical core area due to heavy rains.

6. KPIs specification

Partners have concluded to the following key performance indicators that will verify the success of the HYPERION project to meet its objectives, following the aforementioned requirements sat out by the consortium.

Key Performance Indicators						
Functional	**KPIs**					
	Description	Min Value	Relevant STO	Relevant WP	Dependencies	Means of Verification
KPI_FCN_1	Define X characteristic hazard scenarios per pilot	2	8	3	-	D5.1
KPI_FCN_2	Assess vulnerability in detail for X Tier 1 CH assets per pilot	2	2, 3, 5, 7, 8	2,4,5,6	-	D5.3, D8.6
KPI_FCN_3	Assess vulnerability in detail for X Tier 2 CH or non-CH assets per pilot	3	2, 3, 5, 7, 8	2,4,5,6	-	D5.3, D8.6
KPI_FCN_4	Assess vulnerability in gross for X classes of Tier 3 CH and non-CH assets per pilot	6	2, 3, 5, 7, 8	2,5,6	-	D5.3, D8.6
KPI_FCN_5	In combination, capture at least X % of vulnerable city buildings as Tier 1-3 assets	95%	1, 8	2,4,5,6	KPI_FCN_2, KPI_FCN_3, KPI_FCN_4	D5.3, D8.6
KPI_FCN_6	Assess vulnerability of at least X public utilities (e.g., transportation, power, water, sewage, telecom network) and associated infrastructure per pilot	1	1, 6, 7, 8	2,5,6	-	D5.3, D8.6
KPI_FCN_7	Assess direct and indirect monetary losses, casualties and time-to-recover for X pilots	4	7, 8	2,3,4,5,6,7,8	KPI_FCN_2, KPI_FCN_3, KPI_FCN_4, KPI_FCN_5	D5.6, D8.6

KPI_FCN_8	Obtain present-day insurance premium quotations for non-CH Tier 3 classes for at least X relevant hazard types per pilot	1	7, 8	2,3,4,5,7	-	D5.6, D8.6
KPI_FCN_9	Obtain industry present-day estimates of Average Annual Losses for at least one class of Tier 3 non-CH assets in X pilots	3	7, 8	2,3,4,5,6,7,8	-	D5.6, D8.6
KPI_FCN_10	Generate at least X financial products of parameterized insurance pricing based on HYPERION loss estimates per pilot	2	7, 8	2,3,4,5,6,7,8	KPI_FCN_2, KPI_FCN_3, KPI_FCN_4, KPI_FCN_5, KPI_FCN_6, KPI_FCN_7	D5.6, D7.3, D8.6, D8.8
KPI_FCN_11	Conduct a survey to assess attractiveness of parameterized insurance products in X pilots	4	7, 8, 9	2,3,4,5,6,7,8	KPI_FCN_8, KPI_FCN_10	D5.6, D7.3, D8.6, D8.8
KPI_FCN_12	Propose and test the effectiveness of at least X mitigation strategies per pilot area	2	All	2,3,4,5,6,7,8	KPI_FCN_2, KPI_FCN_3, KPI_FCN_4, KPI_FCN_5, KPI_FCN_6, KPI_FCN_7, KPI_FCN_10	D5.6, D7.3, D8.6, D8.8
KPI_FCN_13	Number of different materials to be tested	16	2, 3, 4, 5, 6	4		D4.1
KPI_FCN_14	Number of different sensors per material	2	2, 3, 4, 5, 6	3		D3.4
KPI_FCN_15	Total number of simultaneous orientations tested	5	2, 3, 4, 5, 6	4,5		D4.3
KPI_FCN_16	Weather stations used per site	1	2, 3, 4, 5, 6	4,5		D4.3
KPI_FCN_17	Minimum number of sites monitored	3	All	4,5,6,7,8		D8.6
KPI_FNC_18	Improved reliability of hygrothermal numerical simulations by integrating a) high	20%	1, 2, 3, 4, 5, 6	3, 4		D4.3

	resolution climate files, b) boundary conditions defined in CFD, c) accurate physical, thermal and hygric material properties defined in the lab.					
KPI_FCN_19	More accurate prediction of deterioration of building materials by integrating a) improved damage functions based on experiments, b) more accurate transient hygrothermal conditions.	25%	1, 2, 3, 4, 5, 6	3, 4	KPI_FCN_18	D4.3
Impact KPIs						
	Description	Min Value	Relevant STO	Relevant WP	Dependencies	Means of Verification
KPI_IM_1	Reduction of the present-day break-even catastrophe insurance premiums.	15%	All	All	KPI_FCN_7, KPI_FCN_8, KPI_FCN_9	(i) Obtain current insurance industry premium quotations and AAL values per KPI_FCN_8/9, (ii) Assess AAL values based on HYPERION data per KPI_FCN_7, (iii) Estimate potential for reduced premiums based on HYPERION data
KPI_IM_2	Decrease the ageing- and risk-related depreciation rate of the building stock.	20%	All	All	KPI_FCN_7, KPI_FCN_12	(i) Assess asset depreciation rate via AAL as percentage of asset replacement value per KPI_FCN_7, (ii) Apply mitigation measures and assess improved AAL per KPI_FCN_12

KPI_IM_3	Increase the resilience (spring-back time) and decrease the vulnerability (damage susceptibility) of the area with regards to direct and indirect building losses(structure level), inside and outside personal local risk (citizen level) and community/business functionality over time (system/community level)	15%	All	All	KPI_FCN_1, KPI_FCN_7, KPI_FCN_12	(i) Assess impact of KPI_FCN_1 hazard scenarios as relevant to pilot studies, (ii) Apply KPI_FCN_12 mitigation strategies, (iii) Measure loss and recovery time with/without mitigation measures per KPI_FCN_7/12
KPI_IM_4	Increase the insurance penetration rate by mean of novel insurance programs such as parametric programs.	20%	All	All	KPI_FCN_8, KPI_FCN_10, KPI_FCN_11	(i) Obtain current insurance industry quotations per KPI_FCN_8, (ii) Generate parameterized pricing insurance products per KPI_FCN_10, (iii) Conduct survey to assess attractiveness per KPI_FCN_11
KPI_IM_5	Reduction of the services disruption after an event by providing rapid financing to facilitate quick disaster recovery.	20%	All	All	KPI_FCN_1, KPI_FCN_7, KPI_FCN_10, KPI_FCN_12	(i) Assess impact of KPI_FUN_1 hazard scenarios as relevant to pilot studies, (ii) Apply KPI_FUN_10 financial mitigation strategies, (iii) Measure service disruption with/without financial tool implementation per KPI_FUN_7/12

KPI_IM_6	Comparison between the estimated business continuity capability, public services functionality, length of disruption, reconstruction costs and number of relocated people achieved in the historic areas (where HYPERION has been adopted) versus predictions for the same areas in their original configuration.	30%	7, 8, 9	All

7. Conclusions

This document includes the complete set of system-level requirements for the Hyperion platform, the use cases for the field trials of the platform as well as the specification of the Key Performance Indicators (KPIs) for the validation the platform.

In the first part (sections 2 and 3) we describe the use cases that will be used to validate and demonstrate the different system components and capabilities to a wide range of stake folders. For this reason, use cases were classified into a set of main categories based on their time relation with the examined event (pre-event, trans-event and post event), the knowledge available during the event (given damage, given hazard and no given), and the time frame for any mitigation actions (long-term vs. short term planning).

In section 4 we provide the functional and non-functional requirements for the HYPERION system, as well as for its subsystems. These requirements were derived (a) from the GA, (b) from user needs described in deliverable D2.1, and (c) from extended discussions between end users and technical partners during the previous period.

In section 5 we study the exact premises where the validation and demonstration of the HYPERION system and subsystem components will be conducted. We assign specific venues to specific use case scenarios, and pin point any issues and hazards that may arise during the deployment phase.

Finally, the requirements and use cases were used to derive a set of key performance indicators that would validate the platform's performance in a quantitative way.