“NAture Insurance value: Assessment and Demonstration”

NAIAD

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Open-Web Based Insurance Value Platform_Outline

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EXECUTIVE SUMMARY

The present document is an overview of the overall architecture and functions of the open-web insurance value platform. The outline, presents the resources needed to develop the platform. It also proposes an outline of the methodology to facilitate the connexion of the platform with different programming environments and webs.

It introduces the idea of the participatory modelling approach to encourage the interactive exchange of information between physical and social scientist and local stakeholders for the insurance and nature protection sectors. It presents an initial overview on how stakeholders are going to be engage and how the platform will contribute to support decision-making.

This deliverable contributes to task 5.1 Data management interface. The outline presented in this document set the basis the correct functioning of the platform that will be available in month 24th. It also set the basis for Deliverable 5.2 and 5.3.

1. GENERAL CONTEXT – NAIAD OBJECTIVES

NAIAD (Nature Insurance Value: Assessment and Demonstration) is a new H2020 European project (started in December 2016), dedicated to assess Nature Insurance Value. The *H2020* **NAIAD** project aims to operationalize the contribution of ecosystems to society's resilience concerning extreme-water-related disasters in Europe and beyond. The goal is to gather existing knowledge and methods (operational objective), but also to characterize information quality and uncertainty in assessment and decision processes. In relation with other partners, the proposed holistic approach will integrate social, economic, and environmental issues in a spatial distribution model that will allow for an effective evaluation of the ES, their vulnerability, and their role in natural hazard protection.

NAIAD focuses on the insurance value of ecosystems, i.e. "the value of the sustained capacity of ecosystems to maintain their functioning and production of benefits despite any disturbance"[1], specifically of benefits regarding water-related disaster mitigation. Some ecosystems can help to reduce the vulnerability of local communities against natural hazards, but they are also vulnerable and exposed to threats such as storms, wildfires, diseases, climate change, etc. Specific management operations might increase their resilience, although possibly involving management costs. NAIAD aims to **bring evidences of ecosystem protection roles, provides integrated hazard assessment methods and tailors innovative business model for insurances.**

NAIAD is organized in 10 work packages (WP). The present document is the first deliverable of WP5 called "Integration of methods and tools".

2. WHY THIS OPEN WEB-BASED INSURANCE VALUE PLATFORM LINKING TO PARTICIPATORY DSS?

The open web-based platform contributes to the three main WP5 objectives; first, WP5 is the integrator of the methods and tools developed in WPs 2, 3 and 4 and the context of the DEMOs (WP6) (www.naiad-nbs.eu). Second, it provides a versatile and tailored portfolio of tools and methods to create an integration chain that facilitates decision-making in adaptation planning for the various DEMOs. Third, it creates a strong link between the planning process and implementation by establishing the link with business models and financial arrangements (WP7) and policy (WP8).

In this WP the integrative participatory modelling approach allows iterative exchange of information between physical and social scientists and local stakeholders for the insurance and nature protection sectors, also including regional planners. In the transition of assessing impacts and risk in management decisions, WP5 will use a decision-making framework with a web and GIS-based multi-criteria analysis tool as a facilitator for planning and implementation in a

1 Definition retained by the European Commission in the document: "Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities", 2015

complex and transdisciplinary decision-making context. The open web-based platform is the main communication tool that allows to connect the integrated framework with the end-users.

We believe that such an open-web platform is needed to allow larger-scale engagement with stakeholders and end-users of Nature Based Solutions (NBS) as well as open the door for the creation of a longer-term feedback channel through which the suitability and sustainability of NBS solutions can be discussed. It will link the outputs of the tools developed in WP2, 3 and 4 into a common mapping and analysis platform of insurance- relevant ecosystem services, physical hazards potential and socio-economic factors such as social risk perception or natural capital accounting.

This platform will be designed to support WP6, 8 and 9 in an enhanced diffusion of the project results and allow end-users to explore the assessment at the scale of the DEMOS, as well as at national and EU scale based on publicly available data. The platform will be designed to act as a hub for biophysical inputs to Insurance Value assessment by allowing users across the EU to populate it with fine data as assessments are carried out, thereby creating an open and constantly improving platform for insurance relevant ES assessment.

The platform will be built in collaboration with WP9 and after an active consultation process with relevant stakeholders to ensure user-friendliness and relevance of the information provided.

3. PROPOSED FUNCTIONS AND OVERALL ARCHITECTURE

The proposed broad functions of the open web-based Insurance Value platform include:

- Information exchange tool: Processed information on NBS and demo sites/stakeholders integrated in the NAIAD web will be connected to the decision support tool so as to have a learning experience with the tool.
- Exploration of options: for a given case (from a set of cases at different scales), users should be able to explore a set of NBS options (proposed by NAIAD) and obtain information on its implementation, potential impacts and costs/benefits.
- Feedback: possibility for users to share their specific cases, leave comments and asks questions in the forum.
- Visualization: different modes of visualizing the impact of NBS: on maps, time series, bar charts, plots.

The project will further explore the possibilities of providing an additional function which is

- Dynamic input of different options: possibility for users to run different alternatives (different NBS, different levels of hybrid grey-green infrastructure) under different scenarios (climate change, land use change upstream etc.).

These functionalities will be reviewed and completed by the deliverable author and updated in deliverable 5.2 Open-web based insurance value platform_v1.0 (due in Month 12).

The overall architecture of the open web-based Insurance Value platform is presented in **figure 1**. The key elements are: a GEODATABASE containing all information on NBS, both for generic cases as well as calculated for specific sites and spatially distributed. The database is fed by the SCENARIO BUILDER consisting of different models (e.g. system dynamics model with underlying socio-economic and hydrologic modelling) that are developed and tested in WP2, WP3 and WP4 and connected with each other (through system dynamics modelling and integrated coding) in WP5.

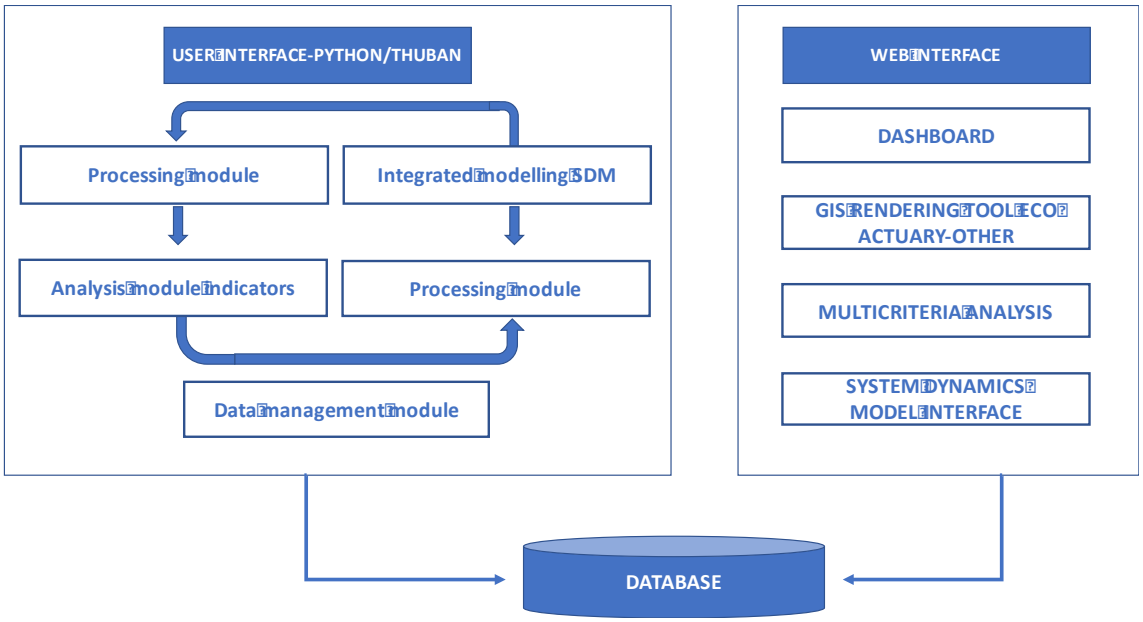

Figure 1. Overall architecture of the web-based Platform.

4. APPROACH - STEPWISE

After an initial analysis of the state-of-the-art on dashboards and web applications allowing to search and explore different NBS, the NAIAD open web-based platform will be built in different steps:

1) **Dashboard**: Dashboard with portfolio of NBS solutions for typical cases based on a series of characteristics (profile of the user, scale, type of water, users…). A first list of discriminatory parameters (see section 7) will be discussed in the consortium and demos and finalized to function as guiding beacons when surfing on the web platform and exploring relevant NBS. The idea is that say a mayor of a city, or a designer in a green infrastructure company, can scroll through the database to find out which are the best

or more suitable NBS to be applied to each case, particularly from the perspective of water risks and insurance value.

2) **DSS proof of concept**: web-based dynamic model for different case studies in which you can visualise the results of NBS implementation in terms of changes of hazard for a different set of scenarios (climate change) and alternatives (different types of NBS).

3) **Scaling up**: Web-based dynamic model as in step 2 for different case studies. This would allow to show the applicability of the platform and NAIAD tools in different settings (urban scale case, basin scale case). In this step, we don't develop new functionalities for the tool, but populate the underlying database with more dynamic information to visualize impacts of NBS in a specific and pre-defined case study.

Depending on feasibility, the platform will be further developed to allow for two-way interaction.

4) **Two-way interaction**: We will explore the options to develop a web-based dynamic model as in step 2, however not bound to a specific case study. The user him/herself could introduce the input parameters of his/her specific case. They would include bio-physical information (such as DEM, land-use maps, climate data), infrastructure layers (artificial drainage, existing hydro infrastructure) as well as socio-economic information on economy and risk in line with the parameters identified as most relevant in WP2, WP3 and WP4, and linked to WP5 through system dynamic modelling or meta-modelling. Uploading and pre-processing of maps, social surveys etc., would be possible.

5. RESOURCES NEEDED

For the steps described under section 4, following resources are needed:

1) The **initial identification of discriminatory parameters** for a set of NBS (see section 7). Depending on the identified discriminatory parameters the database with the structured attributes will be designed. The user will be able to scroll through different parameters (in either serial or parallel steps) and visualizing of information in both maps/pictures and text.

2) Build a **coherent design** to present the information on the NBS to the different end users and their necessities (what is important to know for a mayor, what is important to know for a construction company etc.). The non-spatial component can be developed as part of the NAIAD website as there are no specific calculations necessary. For the spatially distributed rendering of potential NBS, users need to be directed to eco-actuary. In that case you could use eco-actuary to examine the impact of NBS on the hotspots in your area. Biophysical output raster maps, Excel histogram data etc. (WP2) provided by eco-actuary can then be uploaded by the user to the WP5 Web-based platform for use in equations provided by WP3 and WP4.

3) A **dynamic environment is needed to select different NBS and scenarios** in frontend and scripts that allow to find the pre-calculated results in the database and visualize it back in the frontend. In this environment, different modalities to compare the effectiveness of different NBS will be available. For example, multi-criteria analysis component to facilitate choice/negotiation between different options.

4) The same dynamic environment mentioned in point 2 will be used to host a larger database of **spatial information** (There is a need to think about the implications of different scales and structure of the spatial database on raster or vector maps)

5) Data upload module, pre-processing, model environment, feed into a dynamic database as stated in section 2. This task requires a lot more programming work (particularly in automated data check and pre-processing) this means that it is not possible to estimate the time needed until the different models that will be used in WP5 are better known.

PREREQUISITES

- Biophysical output raster maps, excel histogram data and system dynamic models provided by WP2, WP3, WP4, and WP6, and connected in WP5 so that outputs are structured in the Database and available in a format that can run in PYTHON environment.
- VENSIM or METAMODEL is already built and linked to the different models for specific case study (WP5).
- Web environment with broader explanation of NAIAD/NBS exists.

6. EXISTING PLATFORM/CODING

Python will be the overall working language. It facilitates connections with different programming environments and web. Most codes are transferrable into Python as well. For the type of functionalities discussed above, well documented applications/frameworks exist. All of them are OPEN SOURCE and with an active user community.

- Website: JOOMLA, WORDPRESS
- Web2Py
- Leaflet
- Plotly
- GeoDjango – postgress/QGIS: for dynamic GIS content visualizing on web
- PYSD: to translate VENSIM models into python so it can then be used in the same web environment. Vensim also has its own web interface and web-based DSS, however this is licensed.

7. DISCRIMINATORY PARAMETERS

In order to provide the best NBS to the user, a series of preliminary parameters are proposed. These factors would be used to filter different options within the database. The user would create a profile by choosing between different discriminatory parameters such as: sector of employment, scale of area, area type, budget or natural hazard for mitigation. The idea is to create a database with NBS that have been successfully used to mitigate or prevent natural hazards (Focus on those related with water). A rule-based system (also called *expert system*) will be used to manipulate and interpret the data. This type of system has been widely applied in software development to provide an answer to a problem instead of using a human expert.

The system will contain a collection of general principles and rules that would be stored in a 'Knowledge base'. It will also contain a set of discriminatory parameters that will apply to the natural hazard to which the user has to deal with. These parameters will be held in the 'working memory'. The general principles stored in the 'knowledge base', and the discriminatory parameters held in the 'working memory', will be processed by the inference engine that will apply logical rules previously stored in the 'knowledge base' to deduce which NBS is more convenient for the user.

A series of **discriminatory parameters** are proposed as following:

PROFILE OF THE USER: This feature would allow us to provide an appropriate answer depending on the type of user and his or her interests, whether those are for research or for private investment. Additionally, it would provide us with information about the type of users that use our site. Within the website, the user would have to choose between profiles such as scientist, local authority, environmental consultant, private sector, NGO, statutory nature conservation body, Government Company, public institution, insurance company

SCALE: This parameter would provide information about the data resolution needed by the user, and the type of NBS that could be used. The user would have to choose between the following options:

- Local: $1m^2$-$1Km^2$
- Regional: $1Km^2$- 10.000 Km^2
- National: 10.000 Km^2- 100.000.000 Km^2
- Global: > 100.000.000 Km^2

ZONE: This parameter would provide information about the population density, settlements, possible stakeholders and anthropic factors affecting the area. A definition for each option is needed. The user would choose between these options:

- Rural
- Peri- Urban
- Urban
- Rural/Urban

HAZARDS: The user would choose between different the natural hazards that are affecting or are likely to affect the area based on the results of WP2, 3 and 4. Hazards are identified as detailed as possible by using drop-down menus under the main categories. The web-based platform will focus mainly on floods and drought hazards, other types of water-related hazards will also be explored.

- Ground water pollution;
    - Pollution type
        - Organic
        - Inorganic
    - Source of pollution
        - Natural
        - Anthropic

- Poor water quality
- Water pollution by Silting
- Aquatic ecosystems degradation; because of
    - Cause of degradation:
        - Land use change
        - Pollution
        - Fragmentation
        - Overexploitation
        - Natural Hazards (e.g. Fire)
- Floods (Riverine/Urban drainage/Pluvial/Storm surge/SLR/Raising water tables)
- Erosion (Riverbed/Coastal)
- Droughts

INFORMATION NEEDED FROM THE USER: In this section, additional information would be asked in order to provide a more accurate response. The objective of this section is to ensure that the proposed NBS to the user can be applied, and that there are no budgetary or social obstacles to implementation. The order in which these parameters would appear in the web platform should be discussed.

- Budget availability: The purpose of this filtering criteria is to assure the applicability of the NBS in a real scenario with limited budget and aims to identify funding available through EU or national/regional schemes or through business cases developed (output WP4 and WP7).
- Risk perception: Based on outputs of WP3, different risk perception profiles will be listed. The risk perception and overall differences of stakeholders' interests could be a barrier for the NBS implementation. Within the design of the NBS dashboard, the possibility of social conflicts (e.g. Increase of house price) or inequalities benefitting distribution will be explored and included in the assessment for a given case.

LEGAL REQUIREMENT MODULE: Based on WP8's analysis of local and regional legislation and legal requirements in both design, implementation and operation of the NBS, this parameter will further fine-tune the different NBS options for a given profile.

NATURE BASED SOLUTIONS: In the last section, different NBS would be proposed based on the parameters chosen by the user. More than one NBS could be proposed. In this section, a definition for each NBS will be provided, as well as associated benefits or conflicts that could arise if this NBS is applied in the area. In the table below, different NBS have been proposed depending on the risk to be mitigated or prevented.

Table 1. Risks associated with water and Nature Base Solutions to mitigate or prevent them.

Risk	Nature Based Solution
Water Pollution	Bio-Filtration: • Organic filter. • Sand filter. Ponds: • Dry Ponds. • Wet Ponds. Wetlands: • Shallow Marsh • Extended Detention Wetland. • Submerged Gravel Wetland. Rain gardens and bioswales. Infiltration: • Infiltration trench. • Porous Pavement (Permeable pavement)
Floods (Pluvial)	Rain gardens and bioswales. Underground infiltration trenches. Underground storage and infiltration system. Regional stormwater pond. Stormwater wetlands. Tree planting (to stop run-off). Stormwater tree trenches. Detention basins. Intercropping (in agricultural areas, to stop runoff). Land use conversion (e.g. forestry). Rainwater harvesting and reuse combined with establishing sustainable urban drainage systems (SUDS). Flood retention measures within cities (green roofs, green walls).
Riverine Flooding	Infiltration trenches. Wetland restoration (Especially areas of groundwater recharge). Tree planting. Riverside restoration.

	Hydro-Morphology: Re-meandering. Land use conversion (e.g. Forestry).
Droughts	Restore or construct wetlands. Restore or construct grasslands. Rain gardens. Green streets. Groundwater recharge (trough stormwater retention). Restore natural connectivity of rivers. Afforestation in areas with steep slopes.
Aquatic ecosystems degradation	→By Pollution: - Bio-Filtration. - Wetland restoration/Construction. - Riverside restoration/Construction. →By Fragmentation: - Restore rivers connectivity (e.g. restore riparian vegetation). - Increase structural heterogeneity of stream (e.g. Beavers reintroduction*1) - Restore wetlands. →By Land use/Overexploitation - Control overgrazing in area. - Land use conversion to more sustainable practices. - Re-vegetation of riverbanks. → Natural Hazards: - Appropriate grazing management around area (e.g. Peatlands) to reduce wild-fire. - Limit use of fire in nearby agricultural lands.
Erosion	→ Coastal erosion - Protect or restore key ecosystems (e.g. Saltmarshes, mudflats, mangrove forest*2, dunes, seagrass beds). - Protect and restore coastal reefs. - Create shellfish reefs to increase sediments deposition. → Riverbed erosion: - Hydro-Morphology: Re-meandering. - Limit forestry activity near area. - Riverbeds vegetation protection/plantation. - Increase structural heterogeneity of rivers. (e.g. Beavers reintroduction).

*1Controversial topic

*2 Not in Europe.

8. CONCLUSION

The general outline and functionalities of the open web-based platform are such that the tool can facilitate the further integration of methods and tools sought after in WP5, and be tested in WP6. Its modular structure and step-wise development allows for a flexible creation and adaptation of the platform in correlation with the evolving science and demonstration experiences in the different WPs. It also allows dealing with the risk of not achieving the full functionality of a dynamic two-way interactive portal in which end users can upload characteristics of the demo sites at aggregation levels that are not addressed by the dashboard and existing web platforms on NBS.