

Shelter



Solutions & Tools



Universidad del País Vasco Euskal Herriko Unibertsitatea

FACULTY OF ENGINEERING BILBAO UNIVERSITY OF THE BASQUE COUNTRY



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821282

Main objective

Objective

Cost-effective low-carbon technological solutions for prevention, preparedness, response and recovery through building back better and integration with Shelter tools (the Decision Support System and Data Resilience Dashboard).



Highlights



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Highlights

- Six solutions and tools that provide a **robust technological basis** for improving the **protection, resilience and sustainability** of Cultural Heritage buildings and sites for the different **Disaster Risk Management phases** (prevention, preparedness, response and recovery through building back better).
- End-users requirements addressed.



Key challenges

Key challenges

- Address heritage materials, structures and sites specificity and requirements.
- Meet the **great variety** of needs of the Open Labs.



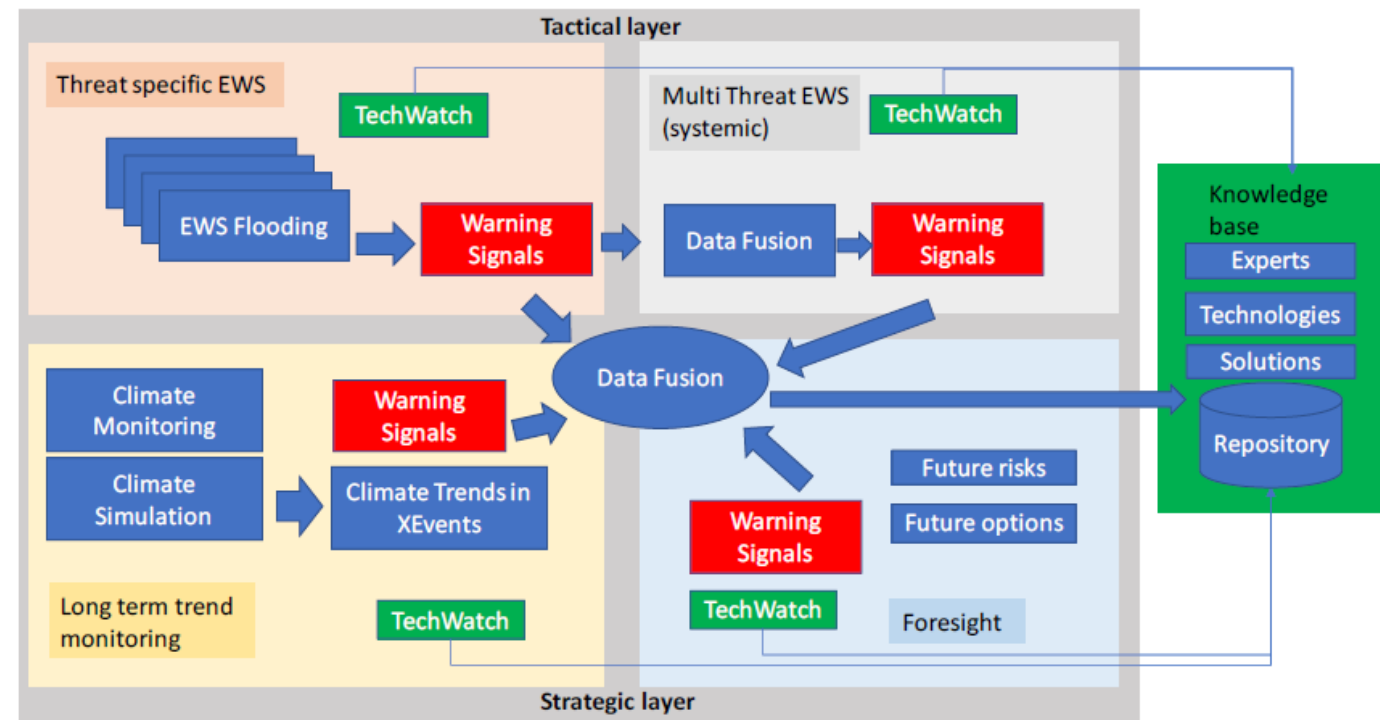
Main outputs

Early Warning System (EWS)

Conceptual model of the **Multi-hazard** Early Warning System tailored for each Open Lab.

Phase of DRM & hazard: preparedness.

Role in Shelter: baseline document for implementing EWS tools.



Solutions Portfolio

148 solutions including a Life Cycle Analysis and Cost Benefit Analysis together with a prioritization tool.

Phase of DRM: prevention, preparedness, response and recovery, as well as emergency phase.

Hazards: floods, storms, wildfires, heatwaves, subsidence, earthquakes.

Role in Shelter: feed Decision Support System.

| | | | | | | |
|-------------------------------------|---|--|--|---|--|--------------------------------|
| Adaptive solution | Timber Laced Masonry construction | | | | Prioritization Index | Shelter |
| DRM phase | <input type="checkbox"/> Emergency | <input checked="" type="checkbox"/> Prevention | <input checked="" type="checkbox"/> Preparedness | <input type="checkbox"/> Response | <input checked="" type="checkbox"/> Recovery & BBB | |
| Hazard | <input type="checkbox"/> Heat waves | <input type="checkbox"/> Flooding | <input checked="" type="checkbox"/> Earthquakes | <input type="checkbox"/> Subsidence | <input type="checkbox"/> Wildfires | <input type="checkbox"/> Storm |
| Action Scale | Building | Function (1) | Building stabilization | Function (2) | | |
| Type of AS | Soft | Vernacular | | Technical requirement | Low | |
| Impact on cultural value: | Yes | | | Reversibility | n/a | |
| Impact on protected HB | No | | | | | |
| Building: | <input type="checkbox"/> | | | | | |
| Façade | <input type="checkbox"/> Material | <input type="checkbox"/> Components | <input type="checkbox"/> Carpentry | <input type="checkbox"/> Colour/finishing | | |
| Roof: | <input type="checkbox"/> Material | <input type="checkbox"/> Volumetry | <input type="checkbox"/> Components | | | |
| Structure: | <input type="checkbox"/> Material | <input type="checkbox"/> Structural system | | | | |
| Public zone: | <input type="checkbox"/> Pavement/material | <input type="checkbox"/> Natural species | <input type="checkbox"/> Path/Gradient | <input type="checkbox"/> Parc / natural environment | | |
| Implementation time | Long time | Pictures | | | | |
| Cost | Low | | | | | |
| Effectivity | Permanent solution | | | | | |
| Maintenance | Medium | | | | | |
| Recyclable | Part | | | | | |
| Reusable | Part | | | | | |
| Impact radius | Building | | | | | |
| Disruption of occupation/use (days) | Low | | | | | |
| CO ₂ emissions | Low | | | | | |
| Description | <p>Timber laced masonry construction is common in Mediterranean countries such as Italy, Greece and Turkey, and the world such as Pakistan. It consists of timber framing as a grid with diagonal elements masonry walls. Timber masonry elements add ductility to the structure. The grid construction absorbs lateral loads as well. As a result,</p> | | | | | |

| INFORMATION SUMMARY | | | |
|--|--|--|--|
| Cultural heritage Hazard Solution | St. Jacob Church located in Brno Flooding which occurs every 50 years and decreases cultural heritage value by 30% Breakaway walls with lifespan 30 years and 100 % impact on hazard | | |
| Current cultural heritage value | 1 000 000 € | | |
| Cultural heritage value in case of hazard occurrence | 700 000 € | | |
| Cultural heritage value in case of hazard occurrence and solution effect | 1 000 000 € | | |
| Value of protected cultural heritage | 300 000 € | | |
| Cumulated impact of the solution on Costs/Benefits of the object | 903 000 € | | |
| Cumulated costs of solving hazard consequences | 2 920 000 € | | |

| BENEFITS AND COSTS IN SOLUTION LIFESPAN (30 YEARS) | | | |
|--|-------------|-------------|-------|
| Excluding cultural heritage value | Benefits | Costs | Ratio |
| Current - without hazard and solution | 3 900 000 € | 1 350 000 € | 2,889 |
| In case of unprotected hazard | 600 000 € | 970 000 € | 0,619 |
| In case of hazard protected by solution | 3 000 000 € | 1 353 000 € | 2,217 |
| Including cultural heritage value | Benefits | Costs | Ratio |
| Current - without hazard and solution | 3 900 000 € | 1 350 000 € | 2,889 |
| In case of unprotected hazard | 600 000 € | 1 270 000 € | 0,472 |
| In case of hazard protected by solution | 3 000 000 € | 1 423 000 € | 2,108 |

RESULT: The ratio in case of hazard protected by solution has higher value than ratio in case of unprotected hazard, and therefore, the solution implementation can be considered EFFECTIVE.

| BENEFITS AND COSTS BREAKDOWN IN SOLUTION LIFESPAN (30 YEARS) | |
|--|-------------|
| Item | Amount |
| Stage | 3 000 000 € |
| on | - € |
| ge | 1 290 000 € |
| | - € |
| | 7 000 € |
| | 50 000 € |
| | 6 000 € |
| ue loss | - € |
| | 446% |

| MAIN PARAMETERS | | HAZARD SELECTION | | Action Scale | | AREA OF EFFECT | | Implementat... | | Cost | | Maintenance | | Effectivity | |
|-----------------|----------------|------------------|------------|--------------|-------------|----------------|--------|----------------|----------------------|------|--|-------------|--|-------------|--|
| DRM PHASE | Emergency | Heat waves | Flooding | Building | Building | Long time | High | Low | Permanent solution | | | | | | |
| | Prevention | Earthquakes | Subsidence | District | Façade | Medium time | Low | Medium | N/A | | | | | | |
| | Preparedness | Wildfires | Storm | Territory | Roof | Short time | Medium | High | Permanent/mitigating | | | | | | |
| | Response | | | | Structure | | | | Temporal solution | | | | | | |
| | Recovery & BBB | | | | Public zone | | | | | | | | | | |

| FILTERED SOLUTIONS | | | | | | | | | | | | | | | | | | | |
|--------------------|---|-----------|------------|--------------|----------|----------------|------------|----------|-------------|------------|-----------|-------|--------------|------------------------|------------------------|---------------------|------|--------------------|-------------|
| ID | Adaptive solution | Emergency | Prevention | Preparedness | Response | Recovery & BBB | Heat waves | Flooding | Earthquakes | Subsidence | Wildfires | Storm | Action Scale | Function (1) | Function (2) | Implementation time | Cost | Effectivity | Maintenance |
| SoL_005 | INTENSIVE and SEMI-INTENSIVE GREEN ROOF | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Building | Water/flood management | Climate adaptation | Medium time | Low | Permanent solution | Medium |
| SoL_052 | Breakaway walls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Building | Building stabilization | Building consolidation | Short time | High | Permanent solution | Low |
| SoL_053 | Pile foundation reinforcement | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Building | Building stabilization | Building consolidation | Short time | High | Permanent solution | Low |
| SoL_075 | Floating basement | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Building | Climate adaptation | | Long time | High | Permanent solution | Low |

Immersite

Simulation tool.

Phase of DRM: prevention.

Hazards: floods.

Role in Shelter: awareness and training.



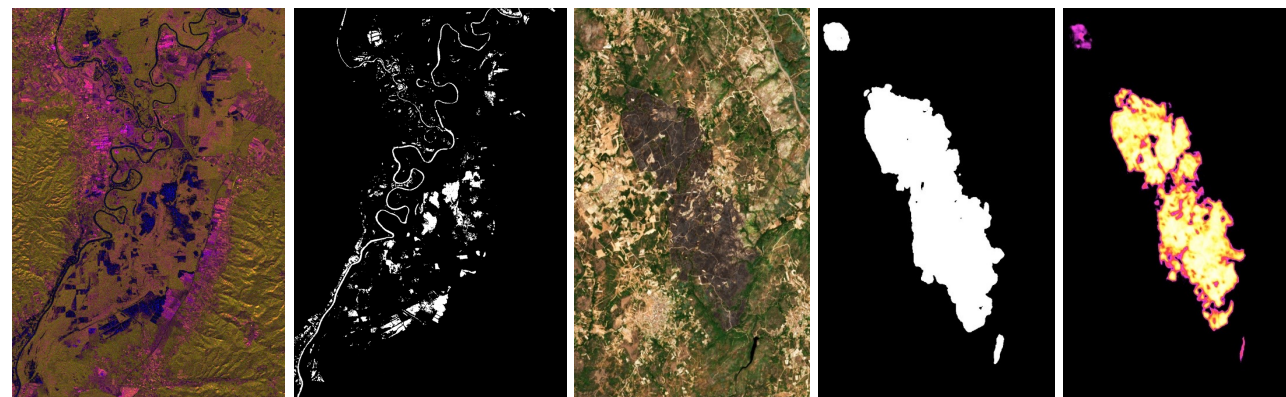
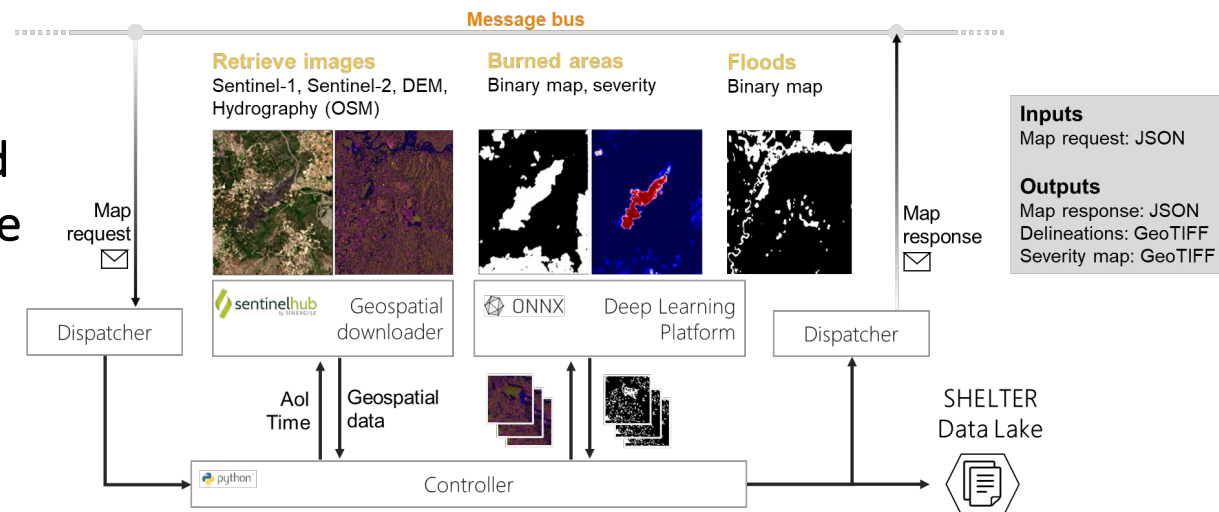
Rapid Damage Assessment Technologies

Automatically compute the **delineation of areas impacted by floods and fires** in a short amount of time and **estimate severity** and the impacted elements.

Phase of DRM: preparedness, response, recovery.

Hazards: floods, wildfires.

Role in Shelter: feed Data Resilience Dashboard.



Crowdsourcing solutions

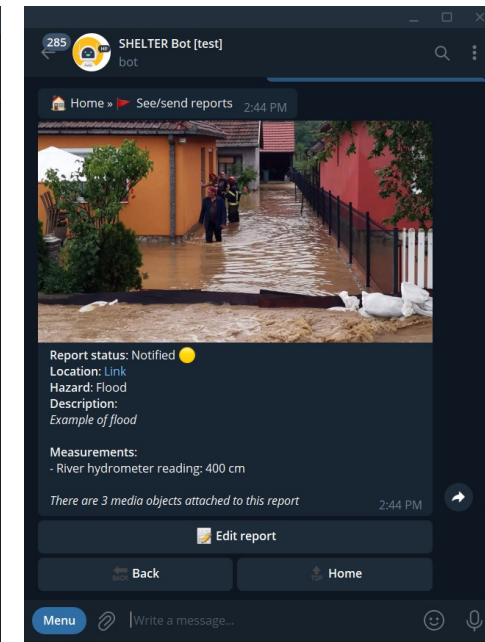
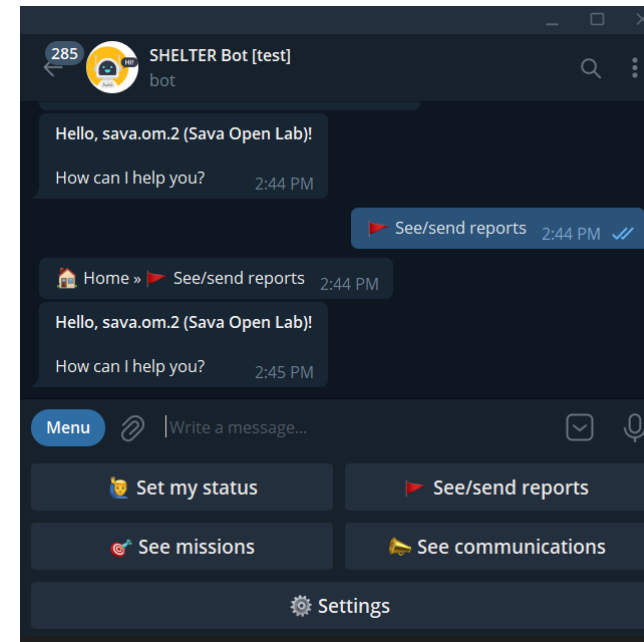
Chatbot: structured data collection process to improve in-field forces management and citizen awareness.

Social media module: to extract meaningful disaster-related information of the ongoing situation and allowing the creation of a curated list of historical events.

Phase of DRM: prevention, preparedness, response and recovery.

Hazards: floods, storms, wildfires, heatwaves, subsidence, earthquakes.

Role in Shelter: feed Data Resilience Dashboard.



Conclusions



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Conclusions

- Useful tools for Cultural Heritage managers that can be tailored to specific needs.
- Four Disaster Risk Management phases and six hazards covered.
- Implemented in user-friendly tools.
- High scientific impact.



THANK YOU!

leire.garmendia@ehu.eus

