# AI and human participation for cultural heritage preservation in emergency settings

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# Deliverable Factsheet

| | |
|---|---|
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| Abstract: | **This study presents and analyses AI-enabled, participatory initiatives that safeguard cultural heritage, with special attention to emergency contexts. Based on specific identification and analysis criteria, the inventory includes 22 initiatives that demonstrably intersect AI, cultural heritage, and citizen engagement.** |
| Keyword list: | **AI, heritage at risk, citizen engagement, emergency, analysis** |
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| | |
|---|---|
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# Partnership

| Name | | Logo |
|---|---|---|
| 1 | University of Luxembourg | uni.lu UNIVERSITÉ DU LUXEMBOURG |
| 2 | Web2Learn | Web2Learn Open, social learning |
| 3 | University of Latvia | UNIVERSITY OF LATVIA |
| 4 | Taras Shevchenko National University of Kyiv | |
| 5 | Europeana | europeana |

# Revision History

| Version | Date | Revised by | Reason |
|---|---|---|---|
| V0.1 | **2/05/2025** | Katerina Zourou (W2L) | First draft |
| V1.0 | **6/5/2025** | Stefania Oikonomou (W2L) | Final version |

## Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

## Disclaimer:

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# List of Abbreviations

The following table presents the acronyms used in the deliverable in alphabetical order.

| Abbreviations | Description |
|---|---|
| AI | **Artificial Intelligence** |
| CH | **Cultural Heritage** |
| EC | **European Commission** |
| HITL | **Human-in-the-Loop** |
| NLP | **Natural Language Processing** |
| PPSR | **Public Participation in Scientific Research** |
| WP2A1 | **Work Package 2 Activity 1** |

# Executive Summary

(WP2 A1) of the AISTER project set out to capture the current landscape of AI enabled, participatory initiatives that safeguard cultural heritage, with special attention to emergency contexts. Through desktop research, the consortium identified **55** European and global projects, peer-reviewed the initial inventory, and retained **22** initiatives that demonstrably intersect AI, cultural heritage, and citizen engagement. The outcome is a peer-reviewed, open-access harmonised dataset, accompanied by a rich suite of interactive visualisations that reveal patterns across technology, participation, ethics, risk, licensing, and heritage focus.

**Methodology**

A structured set of 18 analytical variables grounded in internationally recognised typologies, policy frameworks, and scholarly models, was established under four thematic pillars: Cultural Heritage, Participation, Artificial Intelligence, and Emergency/Crisis. Each variable was formalised through descriptor fields, including scope, central question, analytical tool used, dimensions, and metrics, enabling fast filtering and cross-tabulation. After data cleaning, processing and validation (standardisation, duplicate removal, gap checking), descriptive statistics and cross-tab analyses were performed in Tableau, producing more than twenty interactive visualisations, presented in the report as figures.

**Key Findings**

| Domain | Salient Patterns |
|---|---|
| **Geographic Reach** | Italy, France, Spain, Greece, and Belgium host the highest concentration of projects, with extensive multi-country collaboration across Europe, North Africa, and South Asia. |
| **Project Duration** | Most initiatives run 2–8 years; some are short pilots, others long-term programmes. |
| **Heritage Focus** | Tangible Heritage dominates (movable and immovable assets), supported mainly by Machine Learning and Vision; Intangible Heritage is chiefly addressed through Natural Language Processing (NLP). |

| | |
|---|---|
| **AI Technologies** | Machine Learning, Vision, and NLP account for 80 % of use cases; Robotics is absent. |
| **Risk & Regulation** | Machine Learning and Vision correlate strongly with High-risk AI (EC White Paper, 2020); NLP splits evenly between risk tiers. |
| **Ethics** | Beneficence, Autonomy, and Justice are recognised by >70 % of projects; Non-maleficence and Explicability lag. Ethical integration occurs mainly "by design," with limited real-time or post-deployment governance. |
| **Human Roles** | Corrective, Interface, and Accountability roles are most common in Human-in-the-Loop settings; Stand-in and Warm-body roles are rare. |
| **Licensing** | 45 % of projects release code under liberal open licences; Vision and Machine Learning lead in openness, but several initiatives remain closed or unclear. |
| **Emergency Phases** | Prevention-phase projects are significantly more likely to employ High-risk AI, underscoring the need for rigorous oversight in proactive heritage protection. |
| **Participation** | The dominant citizen-science mode is Contributory; Collaborative and Co-created models are present but less frequent, and no project is Contractual or Collegial. |

The deliverable offers a replicable, typology-driven approach, a harmonised dataset published as open data, and interactive visualisations shared through open licenses (CC BY 4.0). These resources enable researchers, policymakers, and practitioners to track AI adoption trends, benchmark ethical and licensing practices, and identify strategic gaps in heritage protection.

# 1. Introduction

## 1.1. Scope

WP2 A1 produces a peer-reviewed, open-access selection of projects that captures the current landscape of AI-enabled, participatory initiatives for safeguarding cultural heritage in emergency contexts. Through desktop research, project partners:

(i) mapped **55 European and international initiatives** that combine artificial intelligence with citizen or community involvement,

(ii) conducted peer review to validate and enrich the dataset, and

(iii) selected the **22 most relevant initiatives** that demonstrably intersect AI, cultural heritage, and active public participation.

## 1.2. Audience

This report is intended for project partners, researchers, educators, practitioners and policymakers interested in the responsible application of AI in cultural heritage and the promotion of participatory models in emergency and non-emergency contexts.

## 1.3. Structure

The structure of the document is as follows:

1. Introduction and scope
2. Selection criteria and methodology
3. Typology frameworks used for analysis
4. Data processing and cleaning
5. Analytical results and visualisations

6. Conclusions

### 1.3.1. Selection criteria

The search period for the mapped projects was February to March 2025. Inclusion criteria for mapping the projects included:
- AI component: uses at least one AI technology.
- Participatory component: involves citizens/communities beyond simple end-user status.
- Cultural heritage focus: addresses the safeguarding or documentation of any heritage asset.
- Broad risk context (optional): any circumstance that threatens cultural heritage in a broad sense, not required for inclusion.

### 1.3.2. Typology Frameworks for Project Analysis

To systematically categorise and analyse the initiatives collected in WP2A1, a structured set of 18 analytical variables was developed, grouped under four thematic topics: Cultural Heritage, Participation, Artificial Intelligence, and Emergency/Crisis, alongside a small set of basic metadata (title, link, country, timeline). Variables were predefined as categorical fields, nominal, ordinal, or binary, to enable fast filtering and cross-tabulation. These variables were compiled from internationally recognised classification models, policy frameworks, and scholarly typologies relevant to each domain. They provided the lens through which each initiative was interpreted and evaluated and laid the groundwork for subsequent quantitative analyses.

These typologies/analytical models were documented and operationalised through a structured description approach, created in the context of the AISTER project. For each of the 18 variables, a detailed breakdown was provided using the following five descriptors:

1. **Column(s) in sheet**: Indicates where the variable appears in the dataset and how it is referenced (e.g., Column H for Cultural Heritage Classification).
2. **Scope**: Defines the overall objective or analytical focus of the variable.
3. **Question**: States the key inquiry guiding the classification (e.g., "What is the level of citizen participation?").

4. **Analytical Tool**: Refers to the theoretical model, policy framework, or scholarly typology used to structure the classification (e.g., Shirk et al. 2012; UNESCO 2003 Convention).
5. **Dimensions**: Lists the specific categories or values used within the variable (e.g., contributory, collaborative, co-created).
6. **Metrics**: Details the type of data used (e.g., nominal, ordinal, binary), the selection logic (single or multiple choice), and the classification method (e.g., systematic typology).

This structure ensures that each classification decision is grounded in a transparent and replicable analytical logic, while also enabling the dataset to be used for data analysis.

### 1.3.3. Typology Frameworks

The typologies and models for project classification compiled are:

| Topic | Model/typology/classification | Resource |
|---|---|---|
| **Cultural Heritage** | UNESCO taxonomy | UNESCO Conventions 1972, 2003;<br>Ops. Guidelines 2024 |
| **Participation** | Quadruple-Helix model | Carayannis & Campbell 2009 |
| | PPSR model | Shirk et al. 2012 |
| **Artificial Intelligence** | AI technology classification | 7-class tech typology, (ind. used in Mukhamediev et al. 2022) |
| | AI functions | Russell & Norvig 2020 |
| | Applied AI ethics | Morley et al. 2019 |
| | Human-in-the-Loop role | Crootof, Kaminski & Price 2023 |
| | Ethics stage in lifecycle | Chen et al. 2023 |
| | AI risk class | EC White Paper 2020 |
| | AI ethical-impact assessment | UNESCO Recommendation 2021 |
| | Licence openness | Open Knowledge Foundation licences |
| | Licence type(s) | Responsible-AI & OKFN catalogue |

| | | |
|---|---|---|
| **Emergency / Crisis** | Emergency phase | DRR Spiral, Sudmeier-Rieux et al. 2019 |
| | Risk category addressed | UNESCO Risk-Based Classification 2005 |

For a detailed documentation of the typologies/models based on the descriptor fields, look here:
https://docs.google.com/document/d/1Khc4d3elaJtnIzb_0OGwa_Jh2syMygYmZRFIefTKgfM/edit?tab=t.0

### 1.3.4. Data Processing and Cleaning

Before the analysis phase, the dataset underwent a structured data cleaning and validation process to ensure accuracy and consistency:

**Standardisation**: Harmonisation in classification was reinforced through the use of structured drop-down menus following the typologies' labels.

**Duplicate checks**: Projects appearing under different names were de-duplicated.

**Missing data handling**: Blank fields were reviewed and, where possible, completed via secondary sources or flagged as "Unclear."

The cleaned dataset provided a reliable foundation for the data visualisations and cross-thematic analyses presented in the following section.

# 2. Analytical Results and Visualisations

After the dataset cleaning and validation, descriptive statistics were used and cross-tabulations to surface patterns across the 22 retained projects. Results are presented first topic-based and then through cross-cutting views that connect topics.

## 2.1. Distribution Map View

This interactive map visualizes the geographic deployment of individual projects across Europe and other world regions. Each dot represents a project, positioned based on the countries in which it is active. In the published open-acces visualisation, hovering over a dot reveals an interactive tooltip with the project title and a list of participating countries. This spatial representation enables users to explore regional concentrations across the dataset.

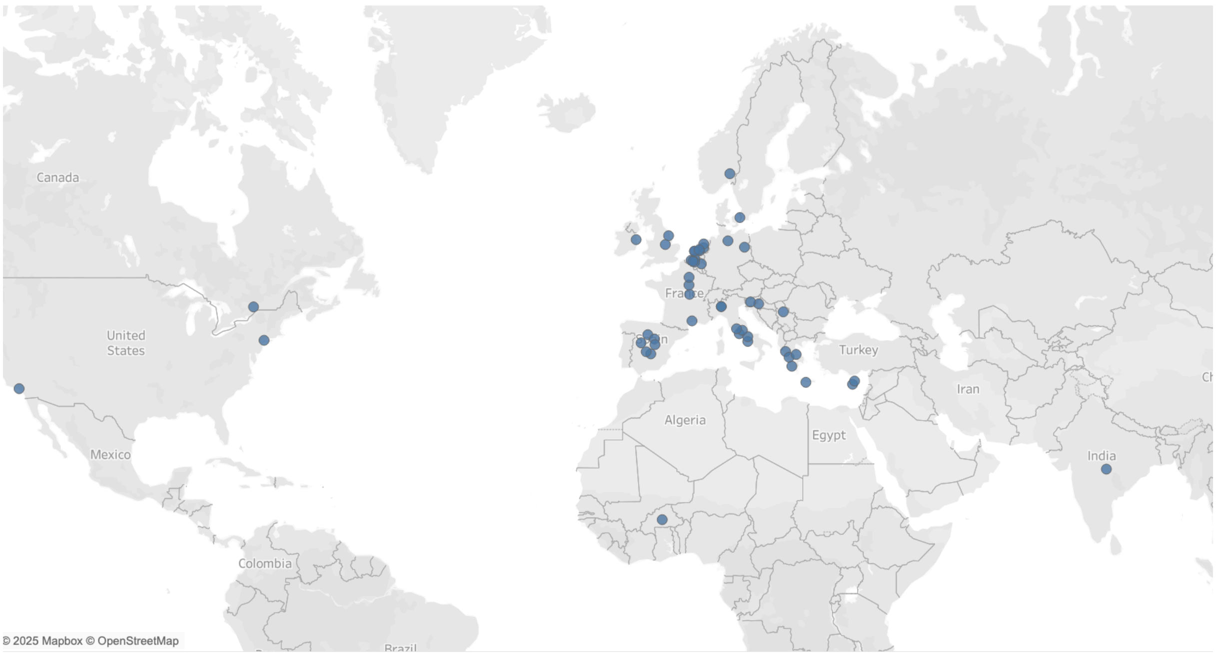


***Figure 1*** *Map View (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.2. Transnational Map view

This map visualizes the geographic span of projects implemented across multiple countries. Colored lines connect locations that belong to the same project, illustrating the extent of transnational collaboration. Each project is represented in a distinct color, with filters on the right allowing users to isolate specific actions. Unlike combined or aggregated views, this visualization focuses solely on spatial connections between project sites. In the published open-acces visualisation, hovering over the map reveals interactive tooltips with detailed information about the project and the countries involved. This view highlights the cross-border dimension of project implementation and emphasizes the regional and global reach of collaborative cultural actions.

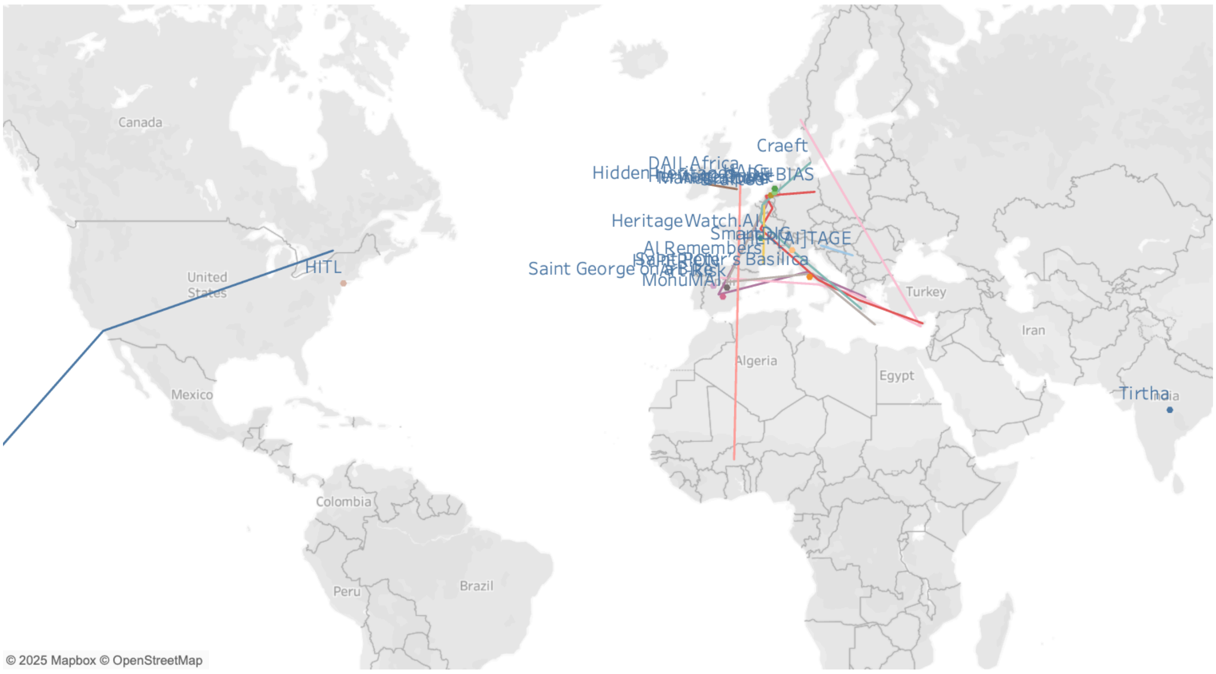


***Figure 2*** *Transnational Projects Map View (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.3. Choropleth Map View

This choropleth map provides an aggregated view of country-level participation across all projects. Each country is color-coded according to the total number of initiatives it is involved in, with darker shades indicating higher counts. The numbers displayed within each country represent the exact number of associated projects. This visualization highlights key hubs of activity, such as Italy, France, and Spain, while also illustrating the broader geographic reach of participation, extending across Europe and into regions of Asia, Africa, and North America. This view supports comparative analysis of national engagement levels and helps identify geographic concentrations of cultural and research collaboration.

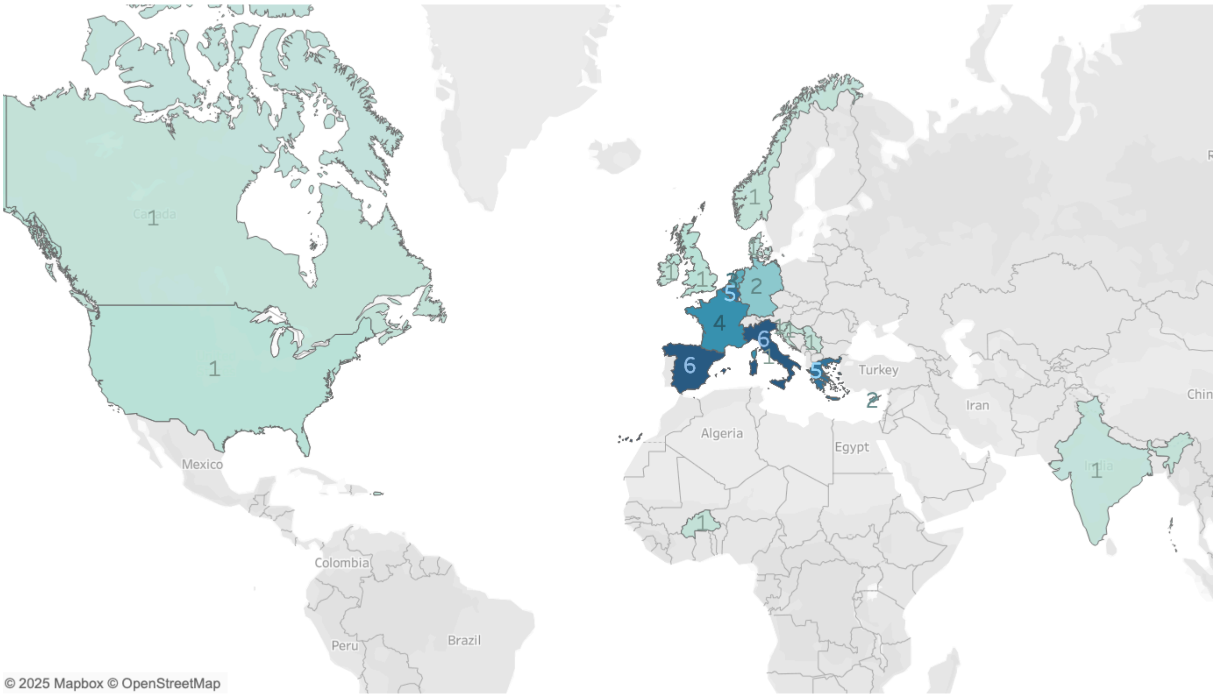


***Figure 3*** *Choropleth Map View (aggregated data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.4. Project Duration

This visualization shows the duration (in years) of each project, based on their start and end dates. Bar length and color intensity represent the total duration, with darker shades indicating longer projects. In the published open-acces visualisation, users can hover over each bar to access the interactive tooltip displaying detailed information for each project and use the side filters to refine the view. The chart includes filters for project status (completed or ongoing) and duration range (2–8 years).

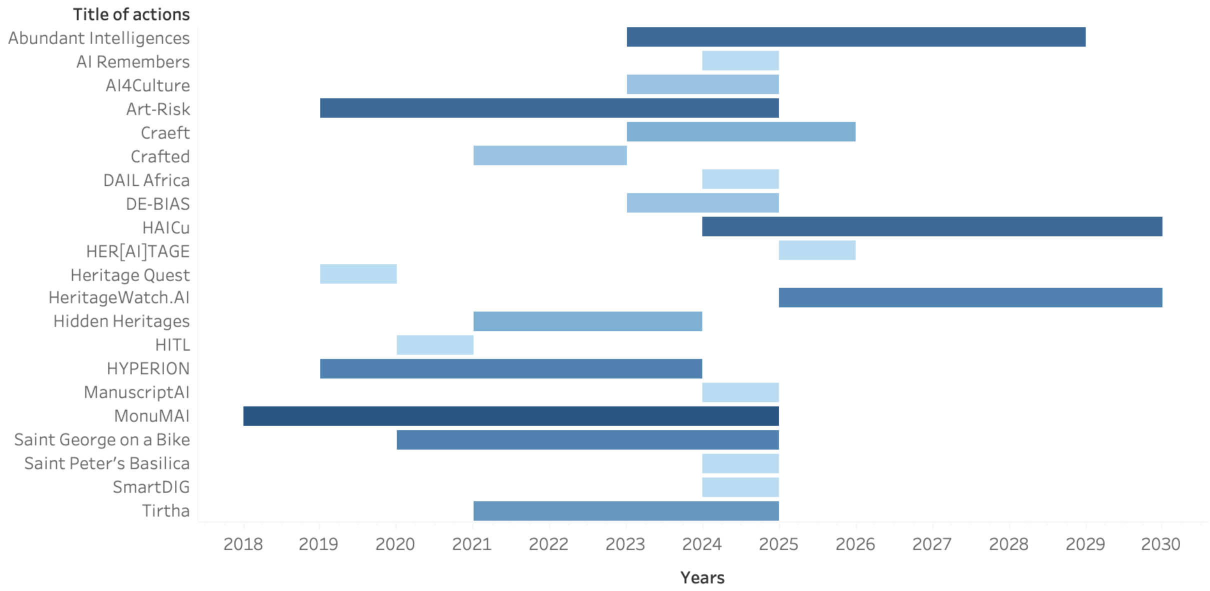


***Figure 4*** *Project Duration (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.5. Project Duration Size

This visualization displays the total duration (in years) of each project, aligned along a common starting point to emphasize differences in length. Each bar's length and color intensity reflect project duration, with darker hues representing longer timeframes. This chart standardizes the start date for all projects to make the variation in duration more visually comparable. In the published open-acces visualisation, interactive filters allow users to explore by project status (completed or ongoing) and to adjust the duration range (2–8 years). Users can hover over each bar to access the interactive tooltip displaying detailed information for each project.

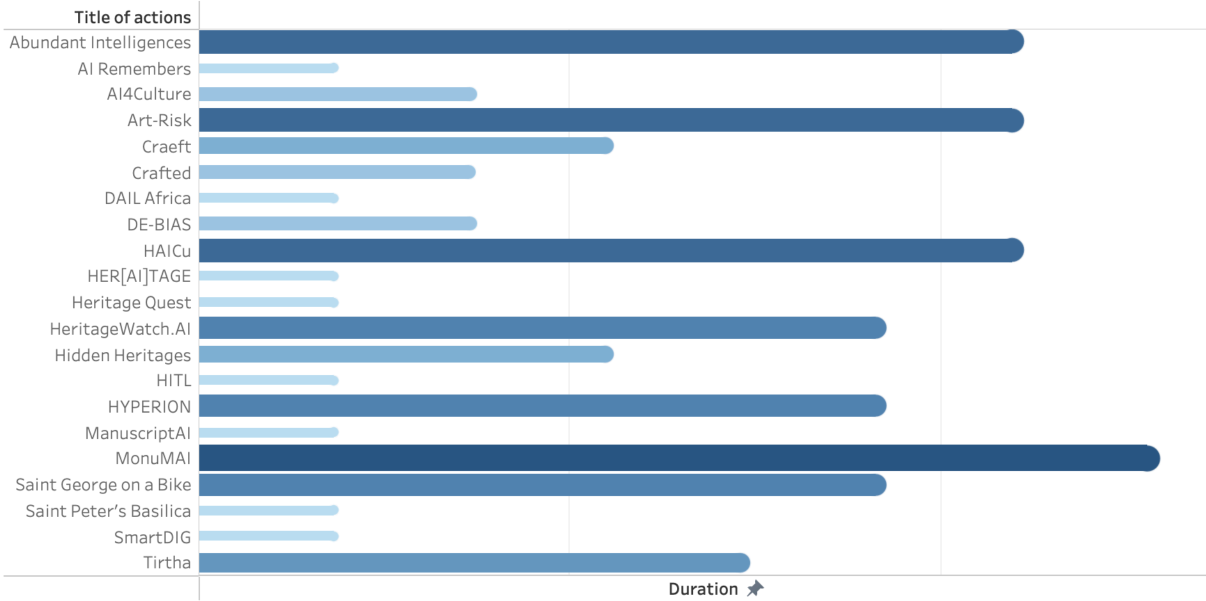


***Figure 5*** *Project Duration Size (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.6. Cultural Heritage Domains and Element Types

This Sankey diagram visualizes the classification of cultural heritage elements addressed by each project, based on the widely recognized frameworks of the UNESCO Conventions (1972, 2003) and Operational Guidelines (2024). Projects are organized into three main Cultural Heritage (CH) Domains (*Tangible*, *Intangible*, and *Mixed Heritage*) which are further subdivided into specific element types. These include, for example, Movable and Immovable (Tangible Heritage), Oral Traditions, Performing Arts, and Traditional Craftsmanship (Intangible Heritage), and Sites with Cultural and Natural Significance (Mixed Heritage). The flow lines connect each element type to the relevant projects, allowing users to trace how individual initiatives align with specific categories. In the published open-acces visualisation, users can interact with the visualization by selecting individual projects, cultural heritage domains, or element types to dynamically explore connections across the dataset. This enhanced view facilitates detailed analysis of how specific initiatives relate to the broader classification of cultural heritage.

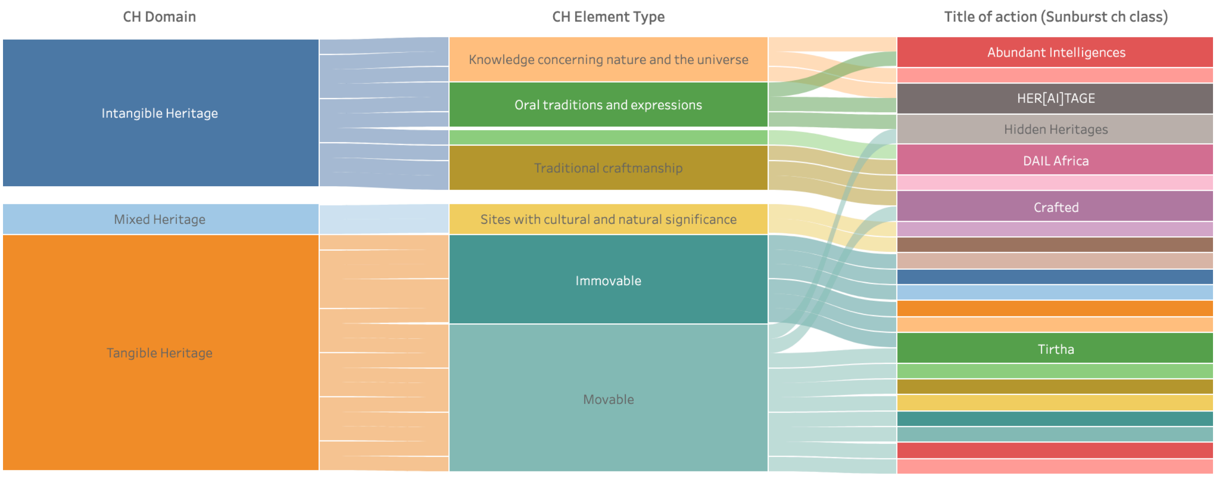


***Figure 6*** *Cultural Heritage Domain Classification View (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.7. Cooperation Model

This radial bar chart illustrates the number of distinct cooperation partners involved in each project, categorized by type: academia, civil society, government, and industry, according to the Quadruple Helix Model by Carayannis & Campbell (2009). The height of each bar corresponds to the number of cooperation models adopted, ranging from one to four. The visualization enables comparison across projects, highlighting those with broader cross-sector collaboration (e.g., *DE-BIAS*, *Crafted*, *HAICu*), and allowing filtering by partner type and number of partners. This representation provides insight into the diversity and inclusivity of each project's stakeholder engagement. In the published open-access visualisation, users can hover over each bar to access the interactive tooltip displaying detailed information for each project.

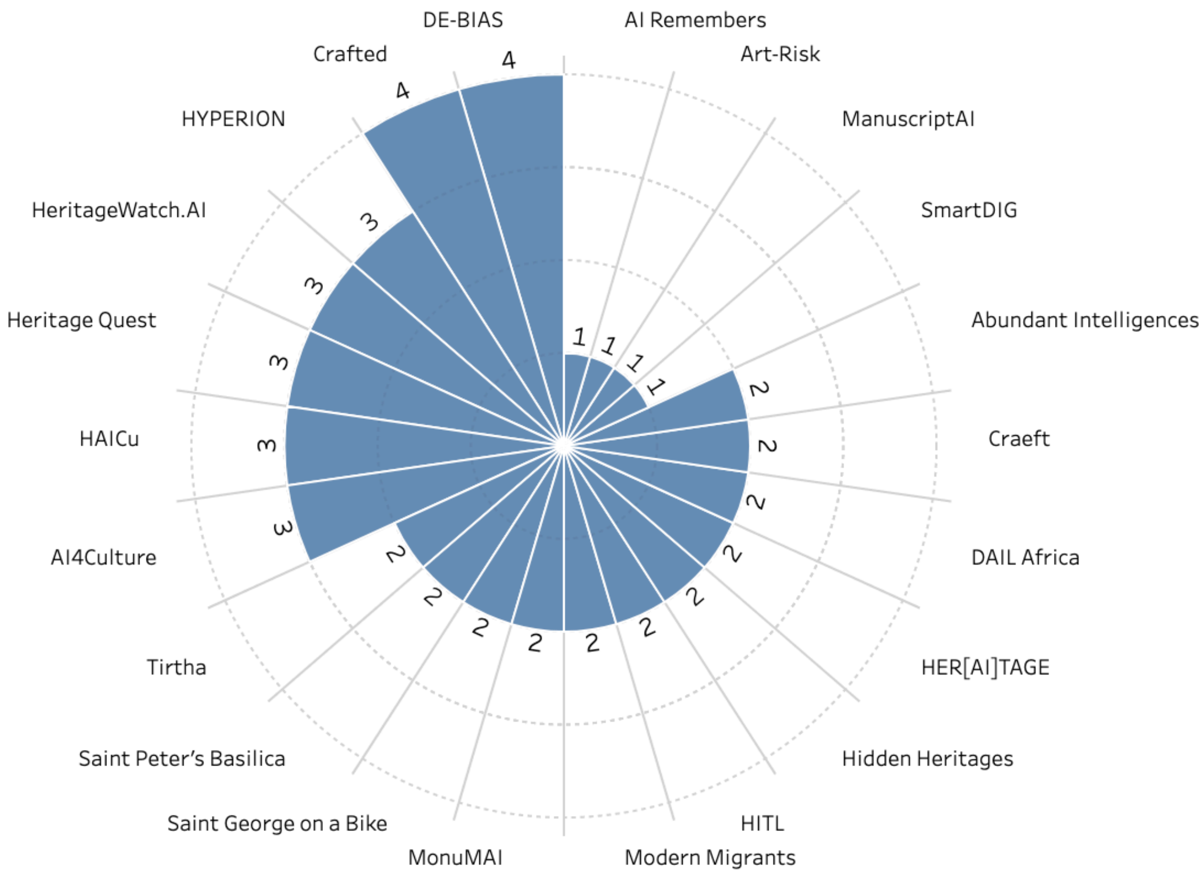


***Figure 7*** *Cooperation Model (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.8.Cooperation Model (Aggregated view)

This radial bar chart presents an aggregated view of cooperation partner types across all projects, following the Quadruple Helix Model by Carayannis & Campbell (2009). The chart displays the total frequency of involvement for each sector, academia (18), industry (11), civil society (10), and government (10), highlighting academia as the most common cooperation partner in the dataset. This high-level overview complements the project-level charts by revealing broader patterns of cross-sector collaboration. Each quadrant represents a distinct partner type, with bar height indicating total occurrences across the full set of analyzed projects. In the published open-acces visualisation, users can hover over each section to access an interactive tooltip displaying detailed information, including the list of individual projects that collaborated with each partner type.

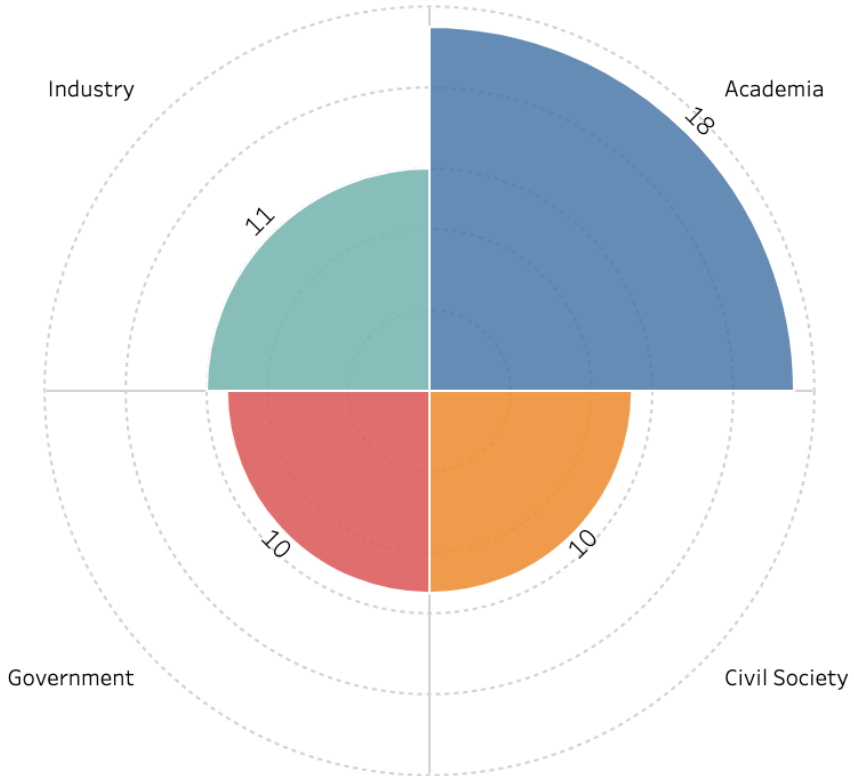


***Figure 8*** *Cooperation Model (aggregated view, data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.9. Citizen Participation

This bubble chart presents an aggregated analysis of the types of citizen participation across initiatives, based on the five-category model proposed by Shirk et al. (2012) for Public Participation in Scientific Research (PPSR). The model distinguishes between Contractual, Contributory, Collaborative, Co-created, and Collegial modes of engagement. In this dataset, projects are distributed across four visible categories, Contributory, Collaborative, Co-created, and Unclear, with no initiatives identified as Contractual or Collegial. Bubble size corresponds to the number of initiatives in each category. In the published open-access visualisation, hovering over each bubble activates an interactive tooltip displaying the number and names of projects in each category. This visualization offers insight into the dominant participatory models adopted, with Contributory participation emerging as the most frequent approach.

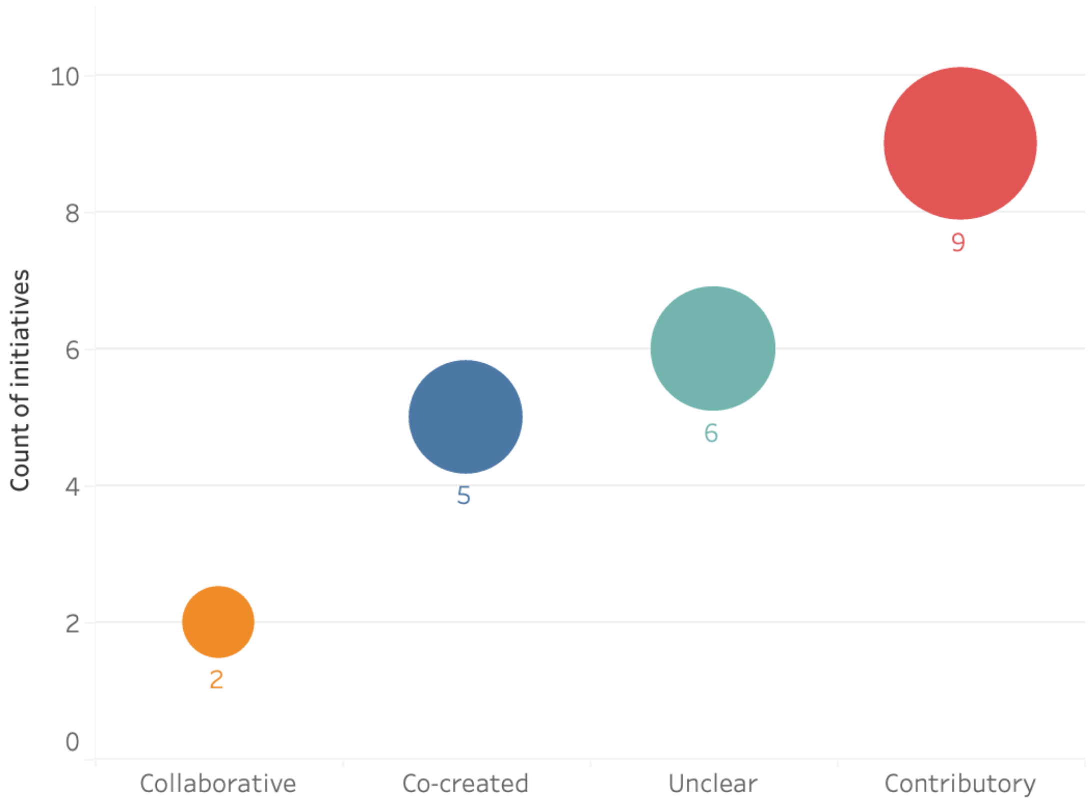


***Figure 9*** *Citizen Participation (aggregated view, data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.10. AI Technology Classification

This matrix chart classifies projects according to the type of Artificial Intelligence (AI) technologies they employ, following a widely accepted categorisation, as also utilised in Mukhamediev et al. (2022). The classification includes seven categories: *Machine Learning*, *Natural Language Processing*, *Expert Systems*, *Vision*, *Speech*, *Planning*, and *Robotics*. Each colored dot represents a project applying a given AI type. While six categories are represented in the current dataset, *Robotics* does not appear in any project. In the published open-access visualisation, users can interact with the visualization by hovering over the dots to reveal tooltips showing the project name and the full list of AI technologies applied. This view enables comparative analysis of technological adoption patterns and illustrates the dominant role of *Machine Learning, NLP* and *Vision* across initiatives.

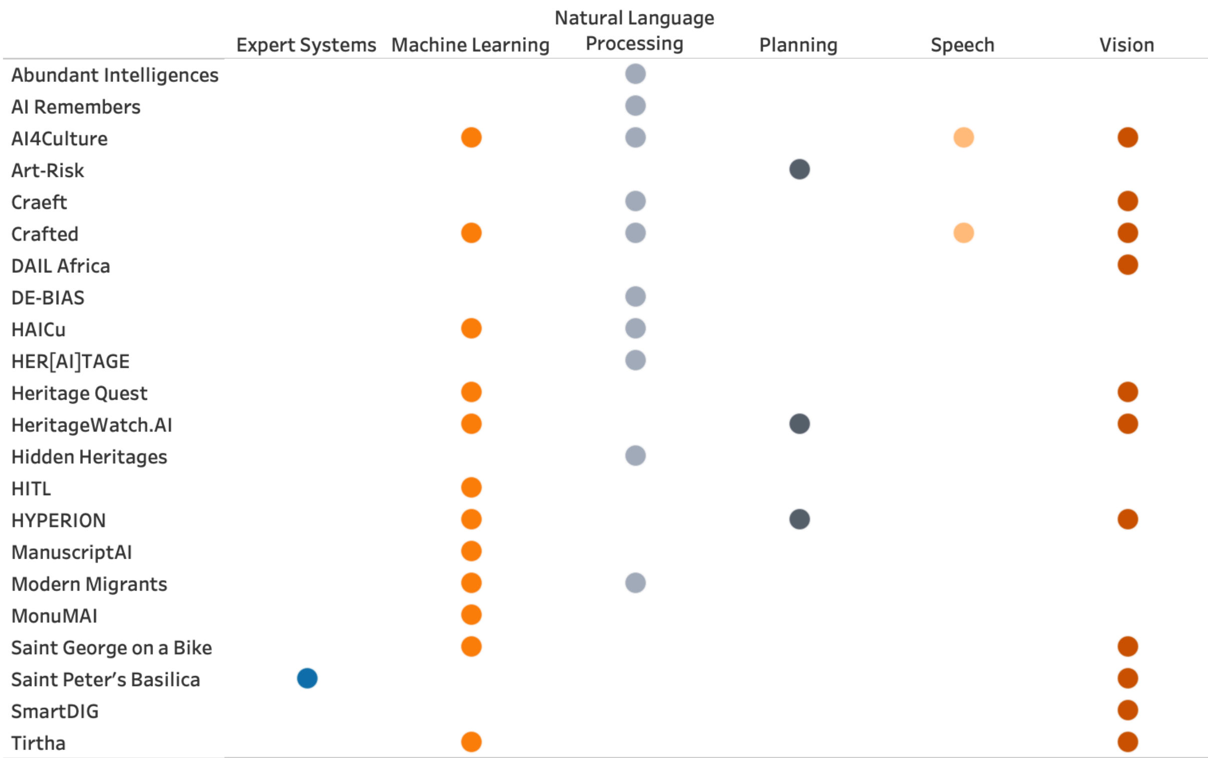


***Figure 10*** *AI Technology Classification (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.11. AI Capabilities Model

This matrix chart classifies projects according to five core AI capabilities defined by Russell & Norvig's Rational Agent Model (Artificial Intelligence: A Modern Approach, 4th ed., 2020): *Knowledge Representation*, *Reasoning*, *Learning*, *Planning*, and *Acting*. Each colored dot represents the presence of a specific capability within a project. An additional *Unclear* category is used when the AI functionality is not explicitly defined. This framework enables a conceptual understanding of how different AI systems operate within cultural heritage projects, from knowledge structuring to decision execution. In the published open-acces visualisation, users can explore the chart interactively, with tooltips displaying the project title and associated AI capabilities.


***Figure 11*** *AI Capabilities Model (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.12. Ethical AI Typology

This matrix chart classifies each project against the five core principles of the Morley et al. (2019) ethical AI typology, *Beneficence*, *Non-maleficence*, *Autonomy*, *Justice*, and *Explicability*, with an additional *Uncertain* category where principles are not clearly defined. Each colored dot indicates that the corresponding ethical principle is addressed in the project's design or implementation. In the published open-access visualization, users can hover over any dot to reveal an interactive tooltip displaying the project title and the full set of ethical principles it implements.

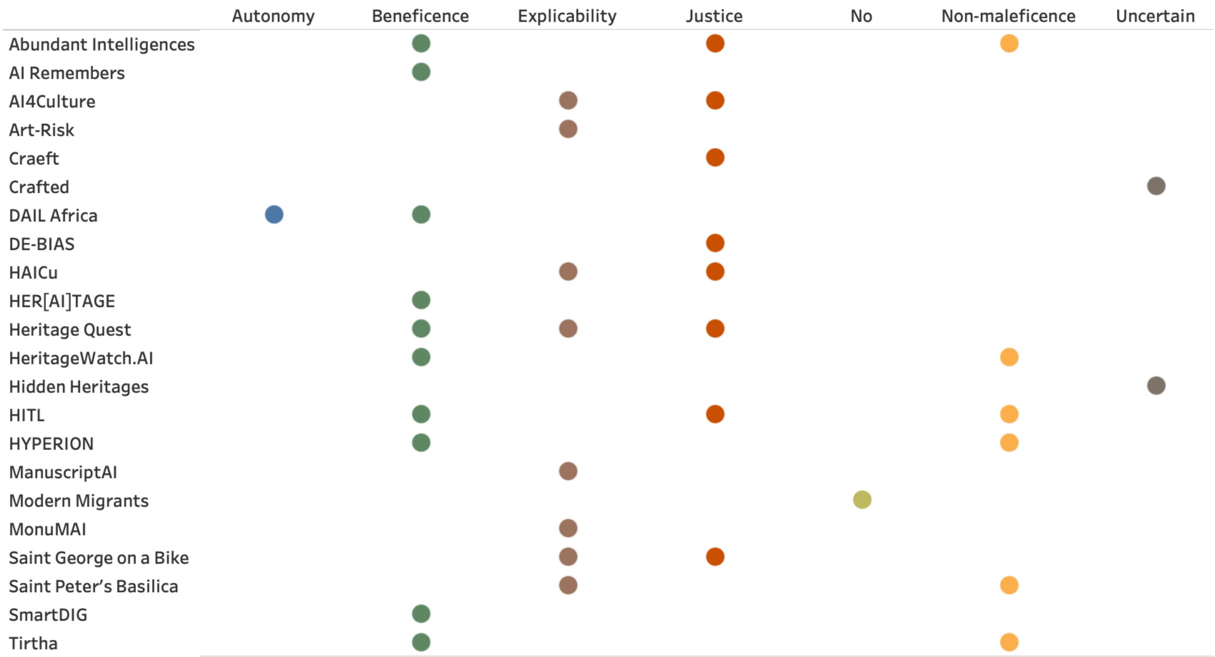


**Figure 12**: Ethical AI Typology (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.

## 2.13. HITL Human Roles

This matrix chart classifies each project according to the nine human roles defined in the typology by Crootof, Kaminski, and Price (2023), namely Corrective roles, Resilience roles, Justificatory roles, Dignitary roles, Accountability roles, Stand-in roles, Friction roles, “Warm body” roles, and Interface roles. Each colored dot marks the presence of a specific human role within the AI decision-making workflow of a project. In the published open-access visualisation, users can hover over any dot to reveal an interactive tooltip showing the project title and the full set of human roles it implements.


***Figure 13*** *Human-in-the-Loop Roles (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.14. AI Ethics by Design Phase

This matrix chart applies the Chen et al. (2023) framework for constructing ethical AI within Human-in-the-Loop systems, categorizing projects by three implementation dimensions: Ethics by Design, Ethics for Design, and Ethics in Design. Ethics by Design incorporates ethics into the initial design phase for predictive risk assessment and debugging, Ethics for Design engages all stakeholders in governance and continuous improvement during deployment and management, and Ethics in Design integrates real-time ethical supervision and monitoring during operation. This chart also categorises the ethical aspects of an AI system along its design phases, to determine when ethical considerations are embedded and how they evolve throughout the AI lifecycle. Each colored dot indicates the presence of a given dimension in a project's workflow, with "No" or "Uncertain" where ethics integration is absent or unclear. In the published open-access visualization, users can hover over any dot to reveal an interactive tooltip showing the project title and all applicable ethical implementation dimensions.

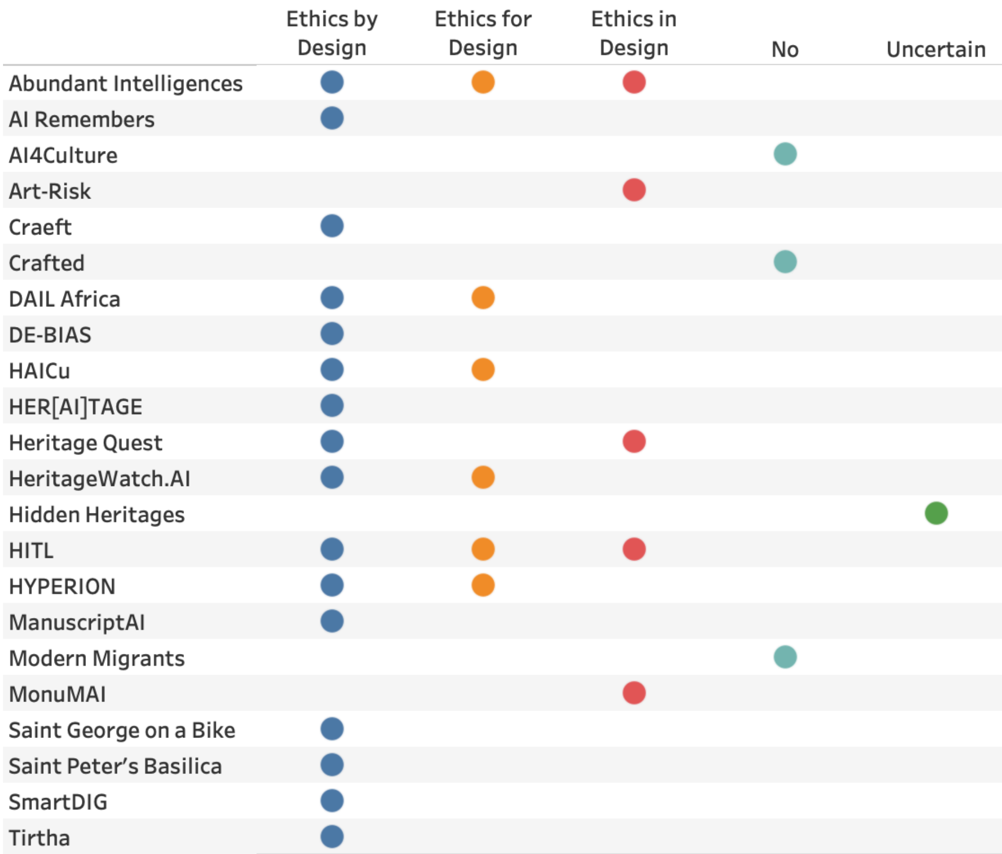


***Figure 14*** *AI Ethics by Design Phase (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.15. Risk-based classification of AI

This matrix chart applies the risk framework from the European Commission's White Paper "On Artificial Intelligence: A European approach to excellence and trust" (2020), categorizing projects into two risk levels: High-risk AI, systems deployed in critical contexts where errors could compromise safety, fundamental rights, or public welfare (e.g., artefact authentication or heritage site preservation), and Low-risk AI, systems used in non-critical functions where any adverse impact is minimal and manageable (e.g., digital cataloguing or visitor engagement). Each dot marks the classification of a project. In the published open-access visualization, users can hover over any dot to reveal an interactive tooltip displaying the project title and its risk tier.

| | High-risk AI | Low-risk AI |
|---|---|---|
| Abundant Intelligences | ● | |
| AI Remembers | | ● |
| AI4Culture | ● | |
| Art-Risk | ● | |
| Craeft | | ● |
| Crafted | ● | |
| DAIL Africa | | ● |
| DE-BIAS | ● | |
| HAICu | | ● |
| HER[AI]TAGE | | ● |
| Heritage Quest | ● | |
| HeritageWatch.AI | ● | |
| Hidden Heritages | | ● |
| HITL | | ● |
| HYPERION | ● | |
| ManuscriptAI | | ● |
| Modern Migrants | ● | |
| MonuMAI | | ● |
| Saint George on a Bike | | ● |
| Saint Peter's Basilica | ● | |
| SmartDIG | ● | |
| Tirtha | ● | |

***Figure 15*** *AI Risk Classification (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.16. Ethical Impact Assessment View

This matrix chart indicates whether each project implements an ethical impact assessment for its AI systems, such as frameworks to identify and evaluate benefits, risks, and human rights implications, including those of vulnerable populations, labour rights, environmental and social impacts, and mechanisms for citizen participation, drawing on the UNESCO "Recommendation on the Ethics of Artificial Intelligence" and its "Ethical impact assessment" tool (2021). Projects are classified with a Yes, No, or Unclear marker. In the published open-access visualization, an interactive tooltip allows users to view any additional description of the assessment approach when hovering over a marker.


***Figure 16*** *Ethical Impact Assessment (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.17. AI License Status

This matrix chart presents the licensing status of AI systems used or developed within each project, referencing the Open Knowledge Foundation's recommended conformant licenses as illustrative examples. Licenses are categorized into three tiers: "Open for liberal creation and/or reuse" (full source code download and creative reuse permitted), "Open-access for limited reuse" (restrictions such as educational use only or no derivatives), and "Private and closed license" (access, modification, and reuse restricted under specific proprietary terms; assumed when source code is not publicly available). An "Unclear" category marks projects where licensing information could not be determined. Users can hover over any dot in the published open-access visualization to view an interactive tooltip with the project title and detailed license information.

| | Open for liberal creation and/or reuse | Open-access for limited reuse | Private and closed license | Unclear |
|---|---|---|---|---|
| Abundant Intelligences | | | | ● |
| AI Remembers | | | | ● |
| AI4Culture | ● | | | |
| Art-Risk | ● | | | |
| Craeft | | | | ● |
| Crafted | ● | | | |
| DAIL Africa | | | | ● |
| DE-BIAS | ● | | | |
| HAICu | ● | | | |
| HER[AI]TAGE | | ● | | |
| Heritage Quest | | ● | | |
| HeritageWatch.AI | | ● | | |
| Hidden Heritages | | | ● | |
| HITL | ● | | | |
| HYPERION | | ● | | |
| ManuscriptAI | ● | | | |
| Modern Migrants | | | ● | |
| MonuMAI | | | ● | |
| Saint George on a Bike | ● | | | |
| Saint Peter's Basilica | | | ● | |
| SmartDIG | | | ● | |
| Tirtha | ● | | | |

**Figure 17**: AI License Status (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.

## 2.18. Cross-Tabulation of Ethical Impact Assessment and Cooperation Partners

This combined view overlays two frameworks to reveal how each sector in the Quadruple Helix model, including Academia, Civil Society, Government, and Industry, engages with ethical impact assessments of AI systems, as defined by Carayannis & Campbell (2009). Each dot represents a project positioned under Yes or No based on whether it applies an ethical impact assessment according to UNESCO's Recommendation on the Ethics of Artificial Intelligence and its 2021 assessment tool. In the published interactive visualization, users can hover over each dot to view the project title and detailed assessment status.

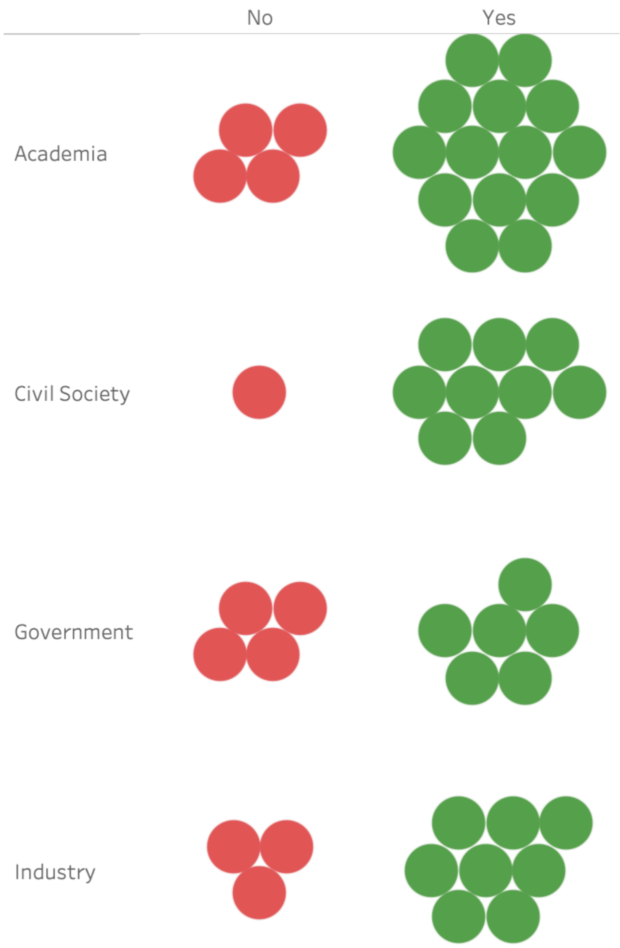


***Figure 18*** *Cross-Tabulated View: AI Ethical Assessment and Cooperation Model (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.19. Cross-Tabulation of AI Risk Classification and AI Technologies

This grouped bar chart overlays two classifications to examine how specific AI technologies align with regulatory risk tiers. AI technology categories (Expert Systems, Machine Learning, Natural Language Processing, Planning, Speech, and Vision) are drawn from the widespread categorisation utilised also by Mukhamediev et al. (2022). Risk tiers, High-risk AI and Low-risk AI, follow the European Commission's White Paper "On Artificial Intelligence: A European approach to excellence and trust" (2020). The chart shows that Machine Learning and Vision applications are predominantly classified as High-risk AI, reflecting their use in critical contexts, while Natural Language Processing projects split almost evenly between High- and Low-risk. Expert Systems, Planning and Speech initiatives also lean toward High-risk but in lower counts. This cross-tabulation supports data-driven governance by linking technological approaches with associated risk considerations.

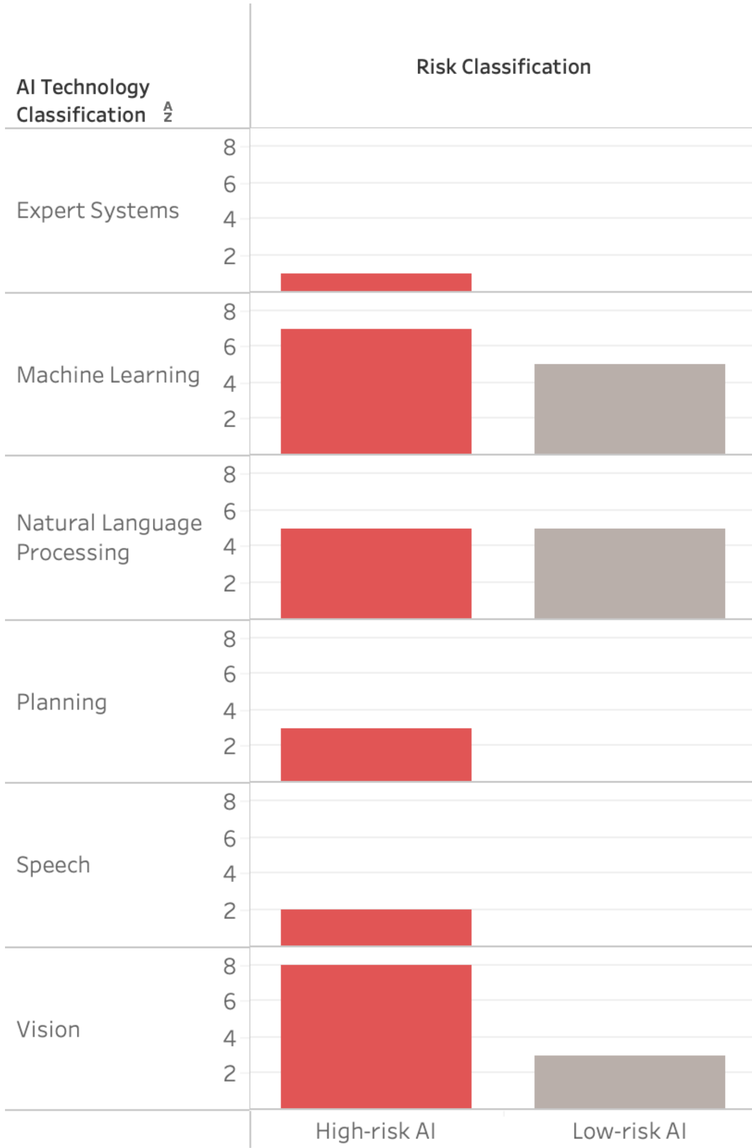


***Figure 19*** *Cross-Tabulated View: AI Risk Classification and AI Technologies Categories (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.20. Cross-Tabulation of AI Technology and Cultural Heritage Domain

This grouped bar chart integrates two classification frameworks to examine how AI technology types align with Cultural Heritage (CH) domains. AI categories (Expert Systems, Machine Learning, Natural Language Processing, Planning, Speech, and Vision) follow the typology also utilised by Mukhamediev et al. (2022), while CH domains (Tangible Heritage, Intangible Heritage, Natural Heritage, and Mixed) are derived from the UNESCO Conventions (1972, 2003) and Operational Guidelines (2024). Bars show the number of projects employing each AI technology within each heritage domain, revealing that Vision and Machine Learning techniques are most frequently applied to Tangible Heritage, Natural Language Processing is primarily used for Intangible Heritage, and Planning systems appear mainly in Mixed Heritage contexts. This cross-tabulation highlights thematic pairings between AI technologies and heritage domains.

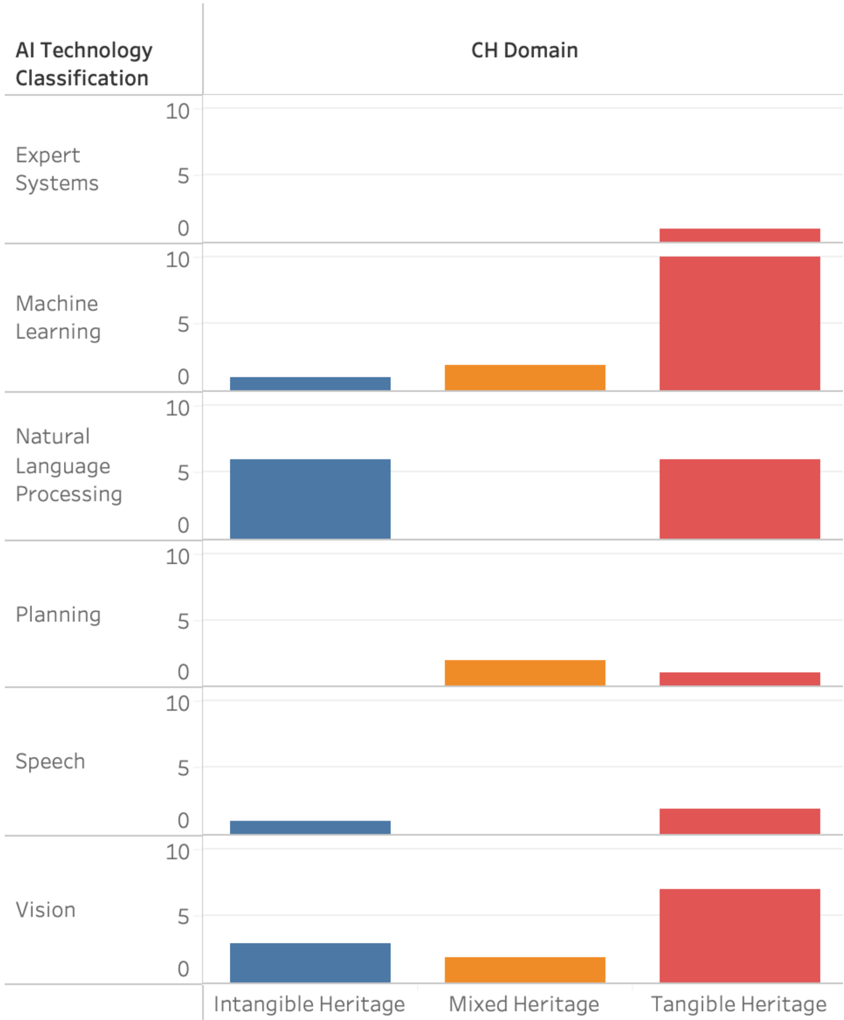


***Figure 20*** *Cross-Tabulated View: AI Technologies and CH Domain (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.21. Cross-Tabulation of Emergency Phases and AI Risk Classification

This paired bar chart combines the Disaster Risk Reduction (DRR) Spiral phases (Relief, Early Recovery, Reconstruction, Prevention, including “No” and “Unclear” as categories), defined by Sudmeier-Rieux et al. (2019, p. 53) with the European Commission’s AI risk tiers (High-risk, Low-risk) from the 2020 White Paper (see above

Figure 15). The DRR phases represent distinct stages of heritage protection, from immediate post-disaster Relief (no projects documented) through Early Recovery, Reconstruction, and ongoing Prevention, to projects not tied to emergency contexts. Bars show the count of initiatives in each phase classified as High-risk AI (left) or Low-risk AI (right). This visualization highlights that Prevention-phase projects most often employ High-risk AI, while non-emergency (No) projects predominantly use Low-risk AI, offering insights for aligning AI governance with heritage risk management. In the published open-access visualization, users can hover over or click on each bar to view the full list of projects corresponding to that category.

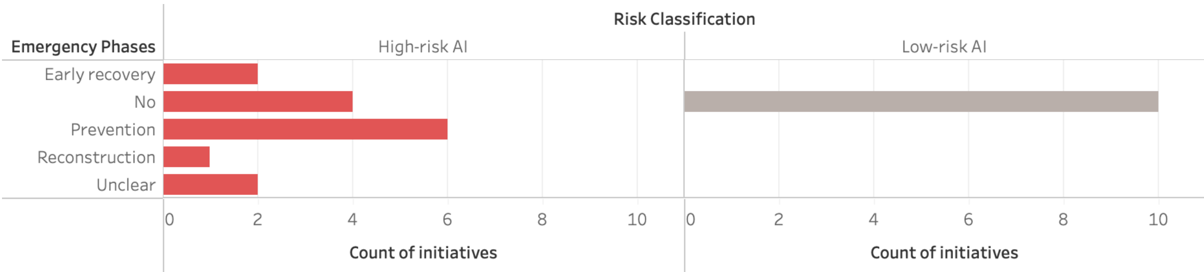


***Figure 21*** *Cross-Tabulated View: Emergency Phases and AI Risk Classification (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.22. Cross Tabulation of AI Technologies and AI License Status

This matrix chart integrates two classification frameworks to show how AI technology types correspond to license status across projects. AI technology categories (Expert Systems, Machine Learning, Natural Language Processing, Planning, Speech, and Vision) follow the typology also utilised by Mukhamediev et al. (2022). License statuses (Open for liberal creation and/or reuse, Open-access for limited reuse, Private and closed license, and Unclear) are based on the Open Knowledge Foundation's recommended license tiers. Each dot represents a project applying a specific AI technology under a given license category. Machine Learning and Vision projects predominantly use open-source or creatively reusable licenses, while several Natural Language Processing, Planning, and Speech initiatives adopt more restrictive or unclear licensing. In the published open-access visualization, users can hover over any dot to reveal an interactive tooltip displaying the project title and detailed license information.

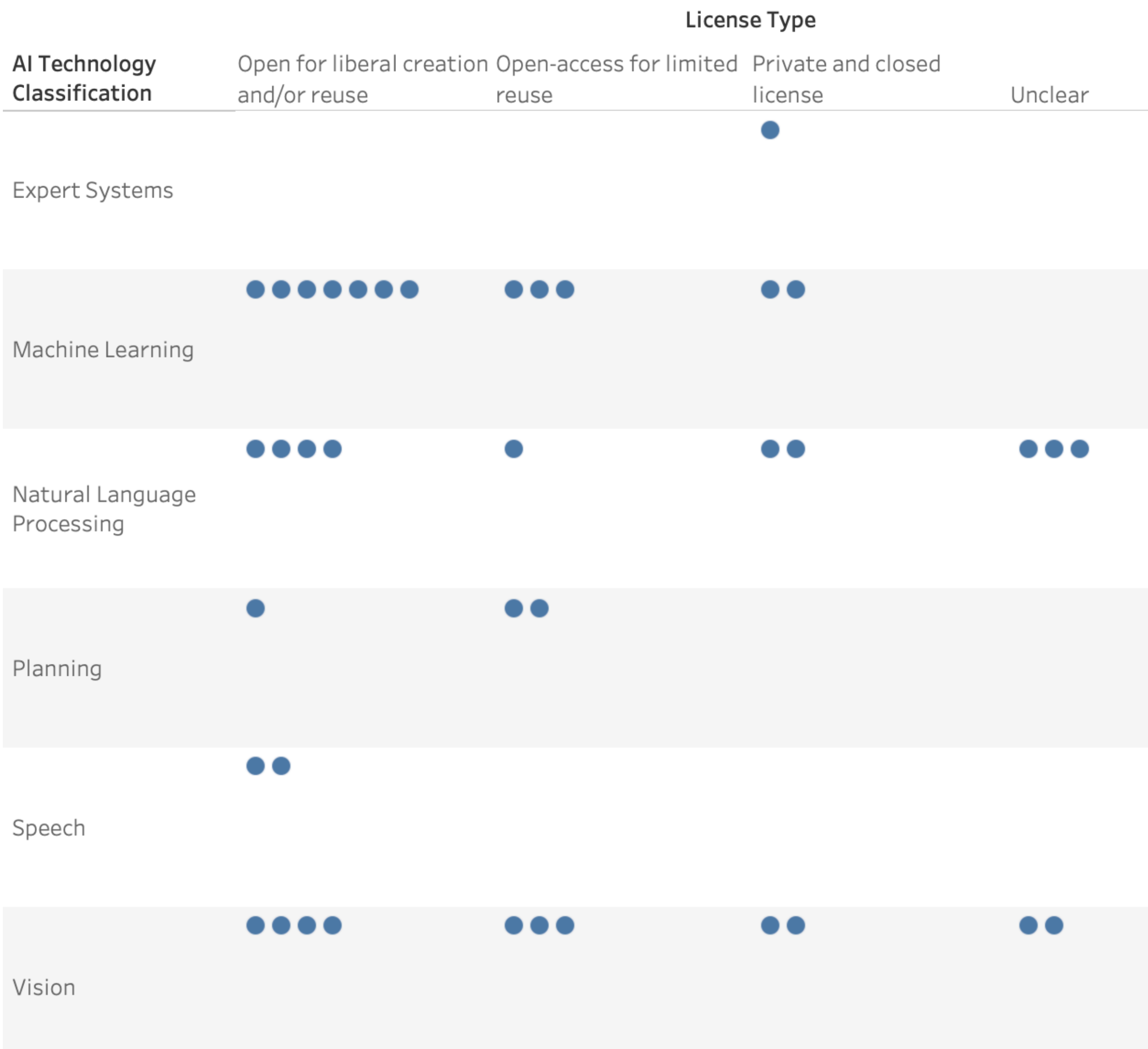


***Figure 22*** *Cross-Tabulated View: AI Technologies and AI License Status (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

## 2.23. Cross-Tabulated Overview of AI Classifications Across Projects

This comprehensive matrix integrates all eight classifications, typologies or models applied in this study to each project, facilitating a holistic comparison of AI characteristics. From top to bottom, the rows represent: AI Technology Classification (Mukhamediev et al., 2022), AI Functional Typology (Russell &

Norvig's Rational Agent Model, 2020), Applied AI Ethics Principles (Morley et al., 2019), Human-in-the-Loop Roles (Crootof, Kaminski & Price, 2023), Ethical AI by Design Phase (Chen et al., 2023), AI Risk Classification (European Commission White Paper, 2020), Ethical Impact Assessment Application (UNESCO, 2021), and AI License Status (Open Knowledge Foundation). Each column corresponds to a project, with color-coded tiers marking the categories or presence of each classification. In the published open-access visualization, users can hover over any cell to view an interactive tooltip detailing the project title and its specific classifications across all typologies.

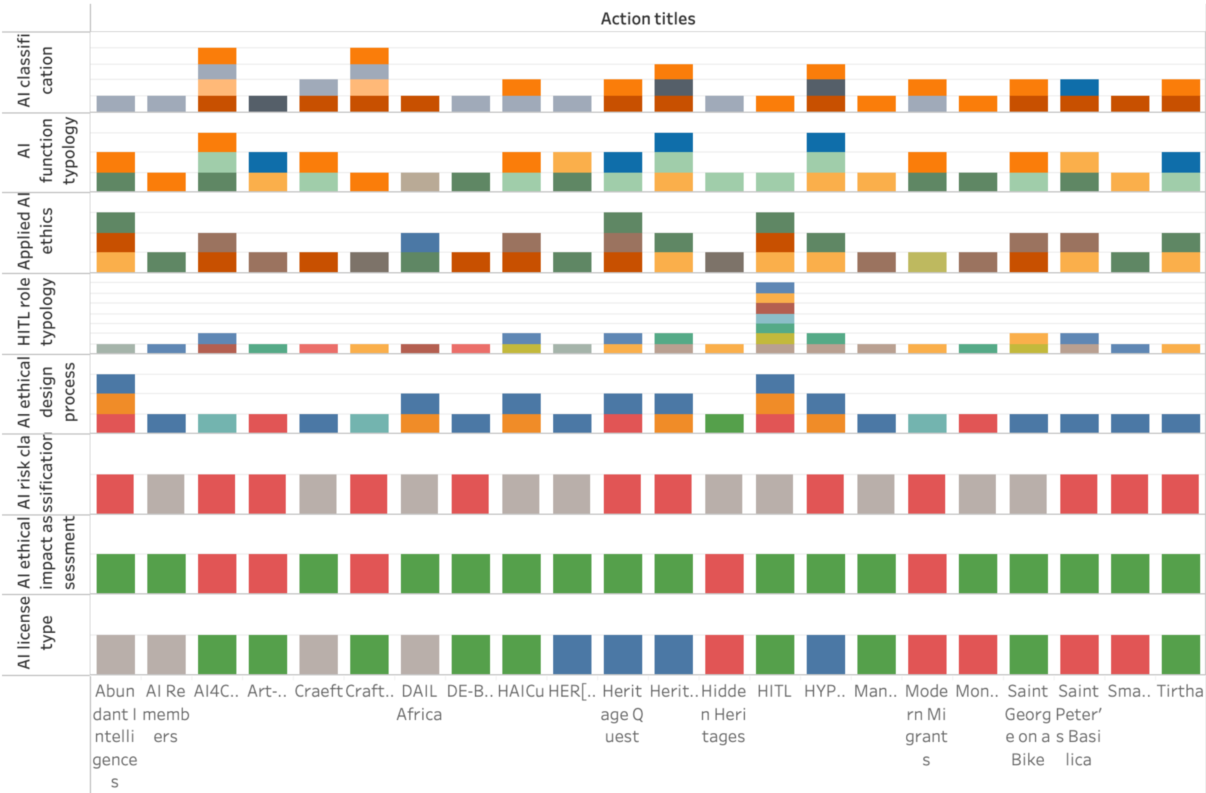


*__Figure 23__ Cross-Tabulated Overview: AI Classifications, Typologies, Models (data analysis and visualization), 2025. Created by Web2Learn for the AISTER project. Licensed under CC BY 4.0.*

# 3. Conclusion

This deliverable mapped, classified, and analyzed 22 AI-enabled initiatives that actively involve citizens in safeguarding cultural heritage. By operationalizing eighteen analytical variables drawn from internationally recognized typologies, classifications, and models, the study produced a harmonized open-access dataset, conducted an exploratory data analysis and produced a suite of interactive visualizations. Together, these outputs provide a first systematic step of a snapshot of how artificial intelligence, public participation, and heritage protection intersect in Europe and beyond.

The descriptive results reveal a geographically diverse field, with project clusters in Italy, France, Spain, Greece, and Belgium, and a clear prevalence of multi-country collaboration. Most initiatives run between two and eight years, yet timelines vary, suggesting both short exploratory pilots and longer strategic programmes. Tangible heritage, with movable and immovable assets, receives the greatest AI attention with projects employing mainly machine learning and machine vision, while intangible cultural heritage is researched primarily through natural language processing.

Across all projects, Machine Learning, Vision, and Natural Language Processing dominate the technological landscape. Machine Learning and Vision are strongly associated with High-risk AI, echoing their deployment in critical tasks such as pattern recognition for conservation or damage detection. In contrast, NLP appears in both High- and Low-risk contexts, reflecting its broader applicability. Ethical practice is uneven: Beneficence, Autonomy, and Justice are acknowledged in most projects, but Non-maleficence and Explicability are less consistently addressed. Where ethics is embedded, it is mainly through “Ethics by Design,” with fewer projects integrating real-time supervision or post-deployment governance. Roughly half of the initiatives conduct a formal ethical impact assessment, and licence openness remains mixed, with Machine Learning and Vision showing the highest share of open or reusable code.

The cross-tabulation data analyses uncover several patterns. Projects in the Prevention phase of the Disaster Risk Reduction Spiral are much more likely to use High-risk AI. Cooperation analysis shows that Academia and Civil Society are the most active promoters of ethical assessments, whereas Industry and Government often engages without them, raising questions about consistent governance across sectors.

Taken together, these findings highlight a field that is innovative but fragmented. To advance responsible AI adoption in cultural heritage, the following priorities emerge:

- Encourage cross-sector capacity building so that Government and Industry actors can match Academia's and Civil Society's awareness in ethical matters,
- Promote open licensing, especially for high-risk applications and for natural language processing, and machine vision software, to improve auditability and public trust,
- Extend human-centred AI developments in the Intangible Cultural Heritage domain that stays underexplored compared to Tangible Heritage
- Increase the agency in civic engagement within AI-driven projects towards more collaborative and co-created participation models, in place of contributory roles.

This study is constrained by the limited number of projects and by reliance on publicly available information, which sometimes left key variables unclear. Future work should extend the dataset, validate results through stakeholder interviews, and examine project outcomes over time. Nonetheless, the detailed typology-driven approach, the harmonized dataset shared as open data, and the published interactive visualizations offer a replicable resource for monitoring of AI developments in the heritage domain supporting civic engagement.

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# Annex A

AISTER WP2A1 Content and Methodology

Data Processing of AISTER WP2A1 Inventory of actions AI/Human participation in CH