Heritage Digital Twin Ontology

60th joint meeting of the CIDOC CRM SIG, 53rd FRBR/LRMoo SIG
and ISO/TC46/SC4/WG9

1-4 April 2025
Digital Humanities, Walter Benjamin Kolleg, Universität Bern

Maria Theodoridou, FORTH-ICS

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UK Research and Innovation

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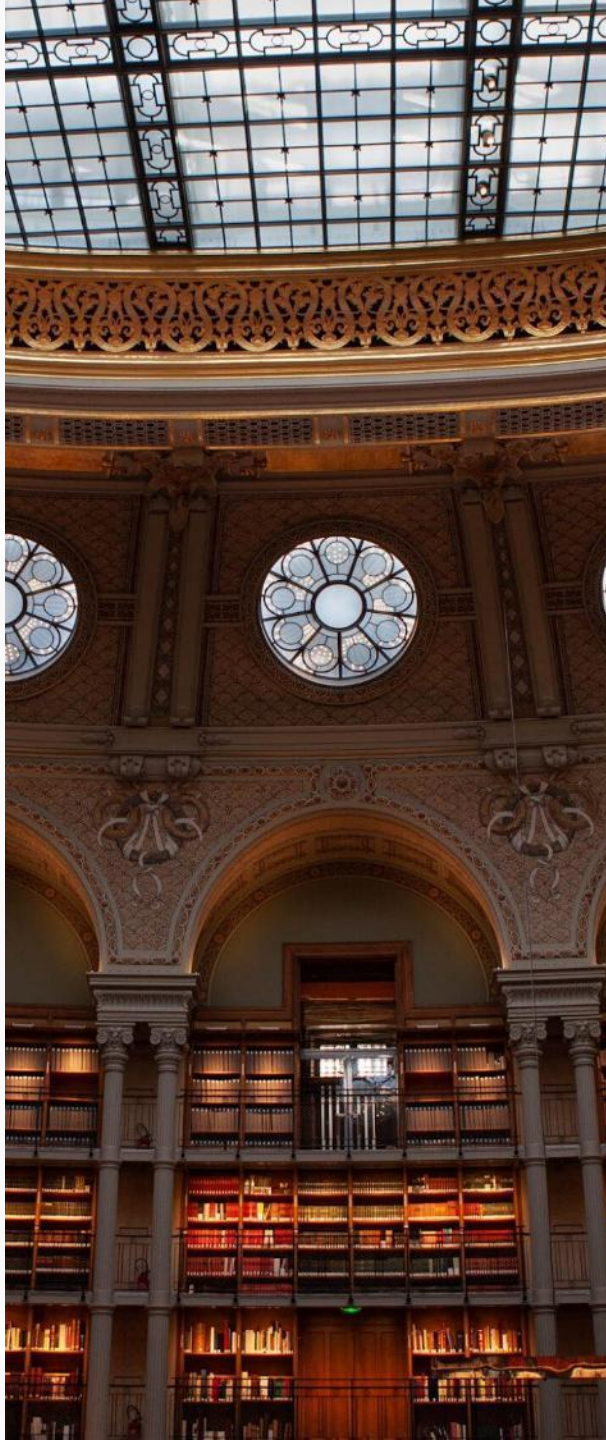
ECHOES: European Cloud for Heritage OpEn Science

Preserving the Past, Shaping the Future:

your Gateway to a Collaborative and Innovative European Cultural Heritage Community

Mission

ECHOES’ mission is to set up the **European Collaborative Cloud for Cultural Heritage (ECCCH)**, a shared platform designed to facilitate collaboration among heritage professionals and researchers, providing them with access to data, scientific resources, training, and advanced digital tools tailored to suit their needs.



ECHOES in Numbers

Beneficiaries	**26**	**5**	**Years**
Affiliated Entities	**16**	**1**	**June 2024 Start**
Associated Partners	**9**	**4**	**Main Pillars**
EU Member States	**15**	**1**	**Crossing Pillar**

ECHOES in Numbers

ECHOES' consortium includes 15 umbrella organizations representing **more than 1000 organisations in Europe**, and a variety of disciplines:

- language as social and cultural data
- art, archaeology, museums
- archives, libraries
- monuments and sites
- conservation-restoration
- cultural management, media culture
- digital cultural heritage
- intangible heritage and more

Strategic objectives

1. **Build an open-source infrastructure** that enables the creation of practical applications driven by CH communities' needs
2. **Move away from an object-focused approach to a holistic approach** to digital transformation of both tangible and intangible assets
3. **Bring together fragmented communities** within the CH sector into a new cohesive community

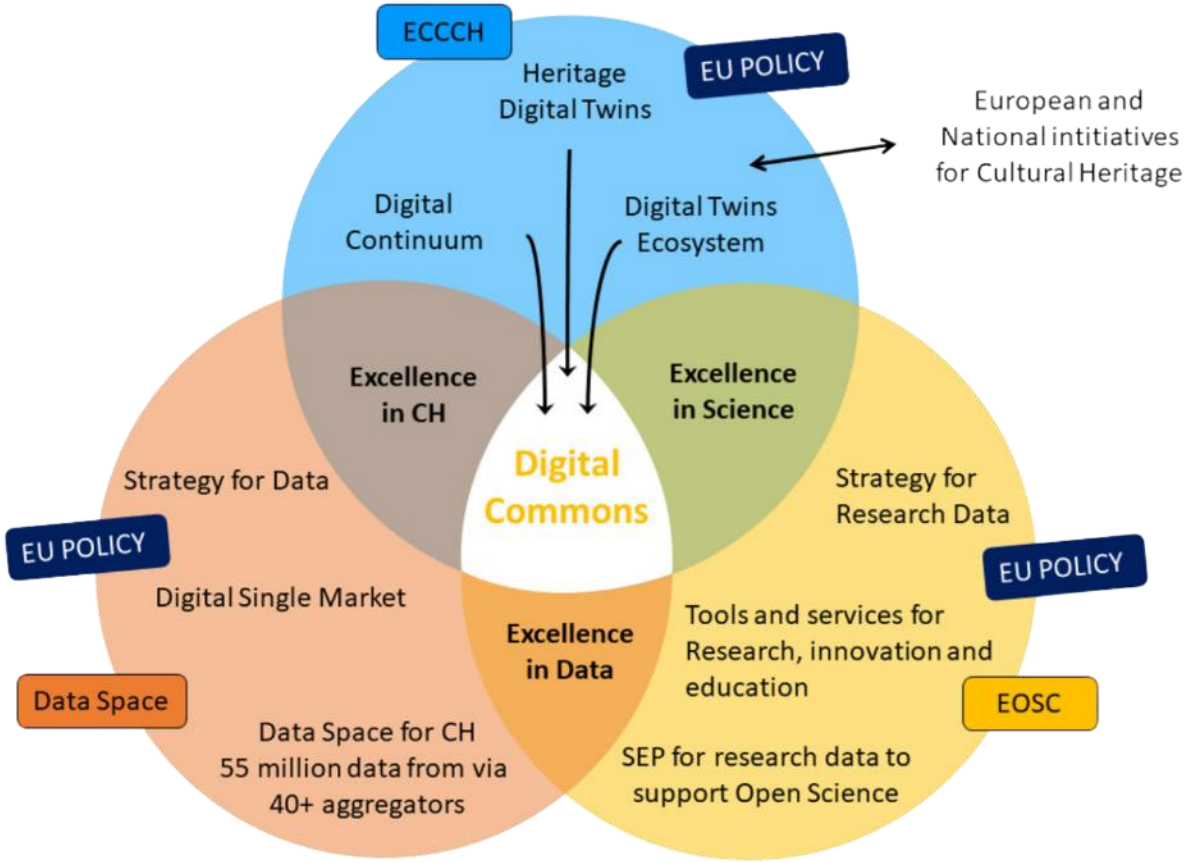
Strategic objectives

4. **Integrate results** of past, current and future ECCCH-related projects regarding data, services, digital processes and applications
5. **Deliver a sustainable and inclusive legal entity** that handles the development, deployment, and maintenance of the ECCCH platform
6. **Enable and foster innovative, collaborative co-creation** of new knowledge around the Digital Commons

The Digital Commons

- ECHOES will create a digital environment which will empower users to interact with, manipulate and enrich **Digital Twins**, leading to new, jointly developed scientific knowledge.

- This digital environment will allow the creation of a new generation of heritage objects, the **Digital Commons**, which are semantically rich and collectively produced.



ECHOES Pillars

Community Pillar

Aims to build and organise the ECCCH community by leveraging the various sectors of CH and provides essential training to facilitate the adoption and use of the Cloud.

Knowledge Pillar

Responsible for creating the cloud infrastructure and setting up the CH Knowledge Base.

Innovation Pillar

Focuses on the development of user-friendly vertical applications and on the assessment of the ECCCH digital ecosystem.

Sustainability Pillar

Aims to establish a legal entity to ensure the cloud's economic, social, and environmental sustainability, securing its leadership both in the EU and globally.

Transversal Pillar

Includes all the activities dedicated to management and communication, as well as enhancing collaboration and integrating data and tools from various projects and complementary initiatives.

Get involved

- ECHOES Cascading Grants Programme will allow the testing of tools and applications developed outside the consortium to integrate them into the ECCCH
- Three Open Calls will be published:
  - **Call 1: Data** (expected to be published in February 2025 - 12 projects, 60.000 € per project)
  - **Call 2: Engagement and Collaboration** (expected to be published in Autumn 2025 - 20 projects, 30.000 € per project)
  - **Call 3: Data and Vertical Applications** (expected to be published in Autumn 2026 - 18 projects, 60.000 € per project)

Heritage Digital Twin Ontology

Previous work

The Heritage Digital Twin: a bicycle made for two. The integration of digital methodologies into cultural heritage research

Franco Niccolucci, Béatrice Markhoff, Maria Theodoridou, Achille Felicetti, Sorin Hermon
https://arxiv.org/pdf/2302.07138
https://open-research-europe.ec.europa.eu/articles/3-64

Populating the Data Space for Cultural Heritage with Heritage Digital Twins

Franco Niccolucci, Achille Felicetti, Sorin Hermon
https://www.mdpi.com/2306-5729/7/8/105

HC1 Heritage Entity

The HC1 Heritage Entity comprises **tangible** and **intangible** entities of the real-world declared as valuable because of their contribution to society, knowledge and/or culture. The value that a heritage entity acquires is relative to the society and culture that assigns it each time. Instances of HC1 may constitute real assets of any nature: physical, both movable and immovable, immaterial, or born digital. They may also constitute types or patterns of cultural events, traditions and practices, typical of the intangible heritage that should be documented with their features and their extent in space and time. Individual events are not considered instances of HC1. Rather, they can be related via their types or patterns to an instance of HC1. An instance of HC1 can be considered as the focal item for aggregating the content of its corresponding HC2 Digital Twin instance.

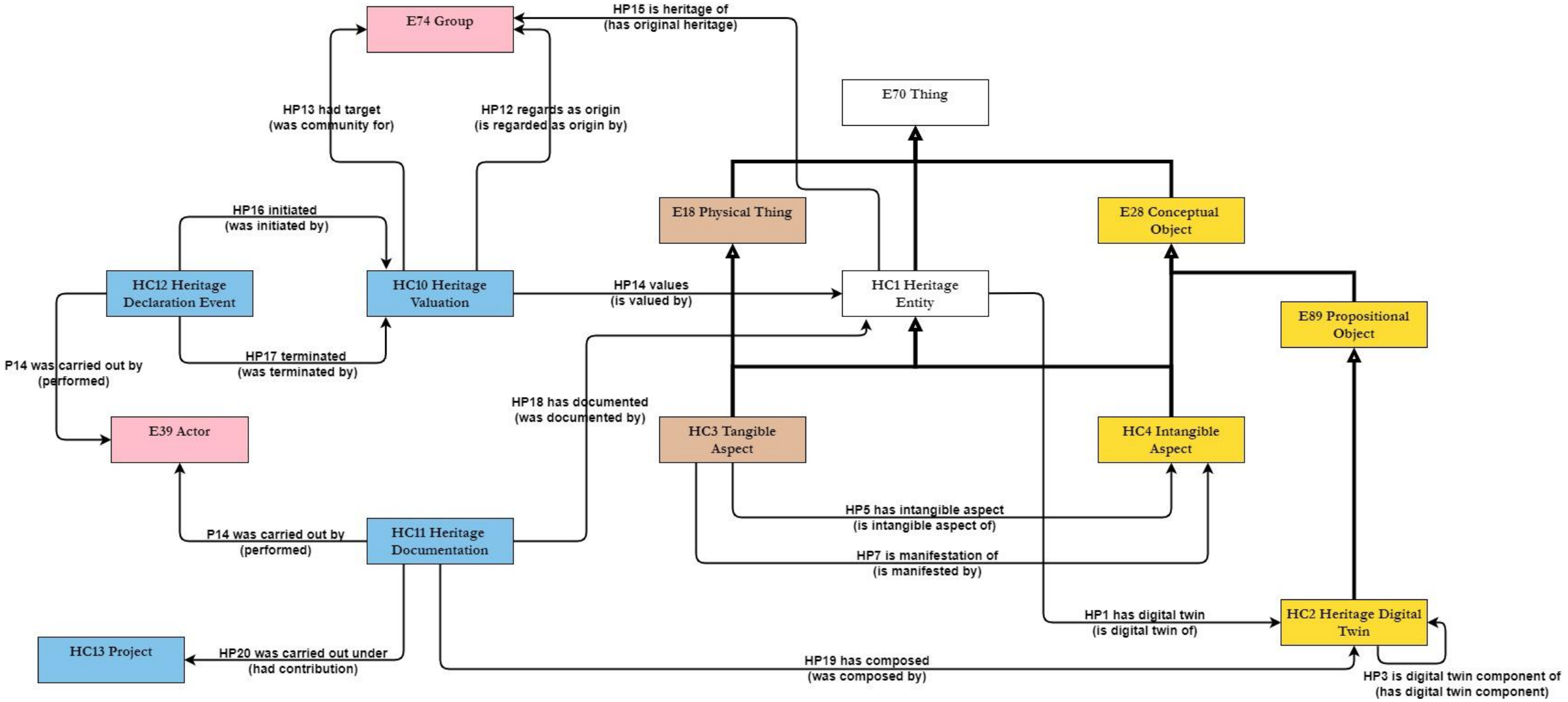
Parts of an instance of HC1 Heritage Entity may or may not constitute Heritage Entities in their own right, such as a shop in a historical building.

the Knossos Palace, part of the Knossos WH archaeological site

the “Palio di Siena”

the Stonehenge Complex, a WH site

Heritage Entity & Heritage Digital Twin

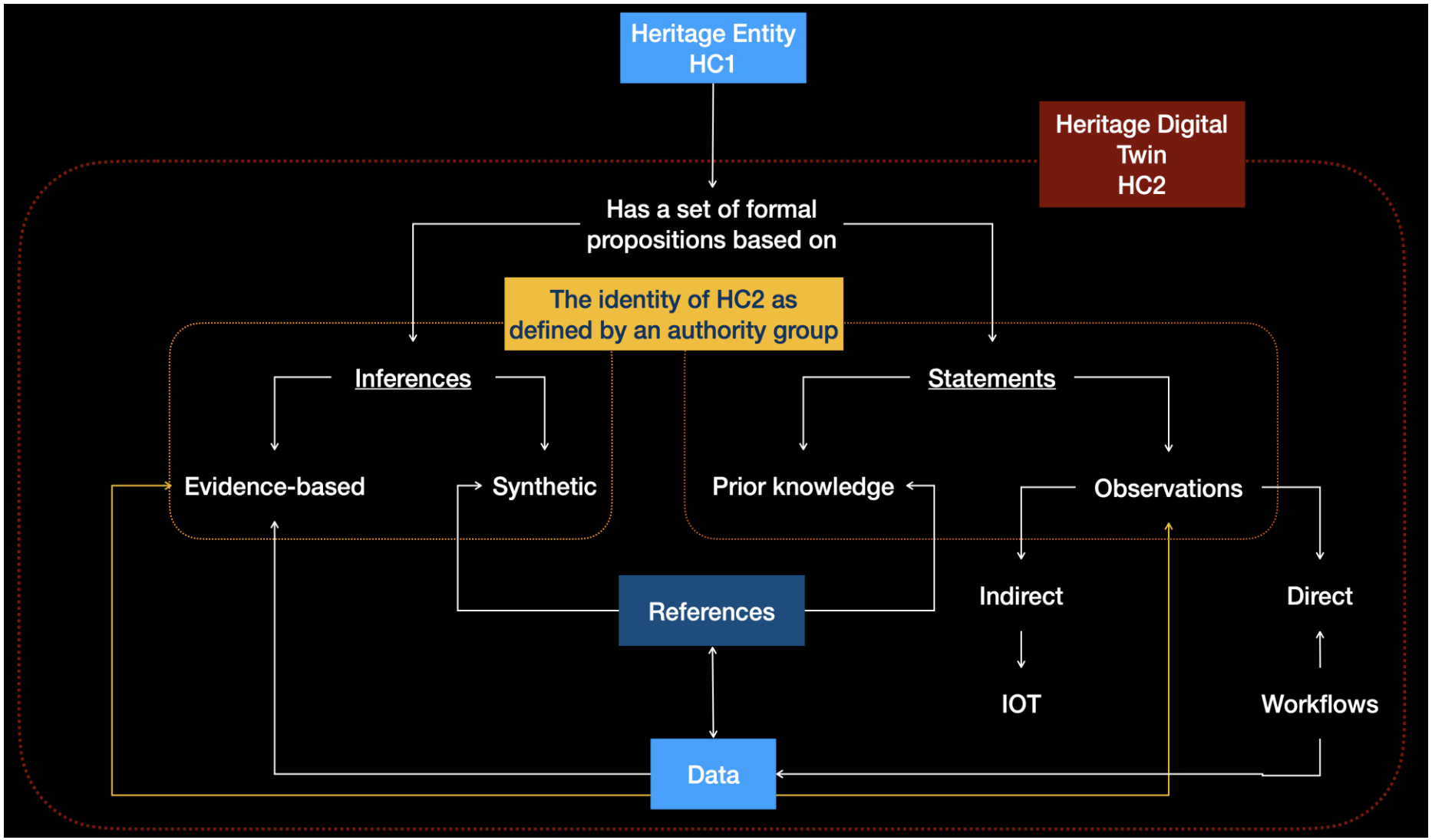


HC2 Heritage Digital Twin

The **HC2 Heritage Digital Twin** class comprises sets of formal propositions more or less directly related to an instance of HC1 Heritage Entity that are documented as single units and serve as topic of discourse about the latter.

Characteristically, the contained propositions may relate information available in a given system including digital visual representations (e.g. 3D models, images, videos), textual descriptions (e.g. digital documents, narrations or stories), information of the effects or images of events that influenced or/and are related in any way to the state of the respective Heritage Entity (e.g. earthquakes, floods etc.) and of activities (e.g. restorations, conservations etc.) carried out on it.

The identity of an instance of HC2 Heritage Digital Twin is determined by its content (set of statements) and the creating authority group. In the context of the defining project or authority, every instance of HC1 Heritage Entity should linked to one instance of HC2 Heritage Digital Twin being valid for a specific time-span. It aims at providing an archive of the documented history, traits and social relationships of the corresponding HC1 Heritage Entity. However, there may be multiple declarations of instances of HC2, created by different projects, that may overlap or include each other. Digital Twin existence depends on the continuous valuation of a Heritage Entity.

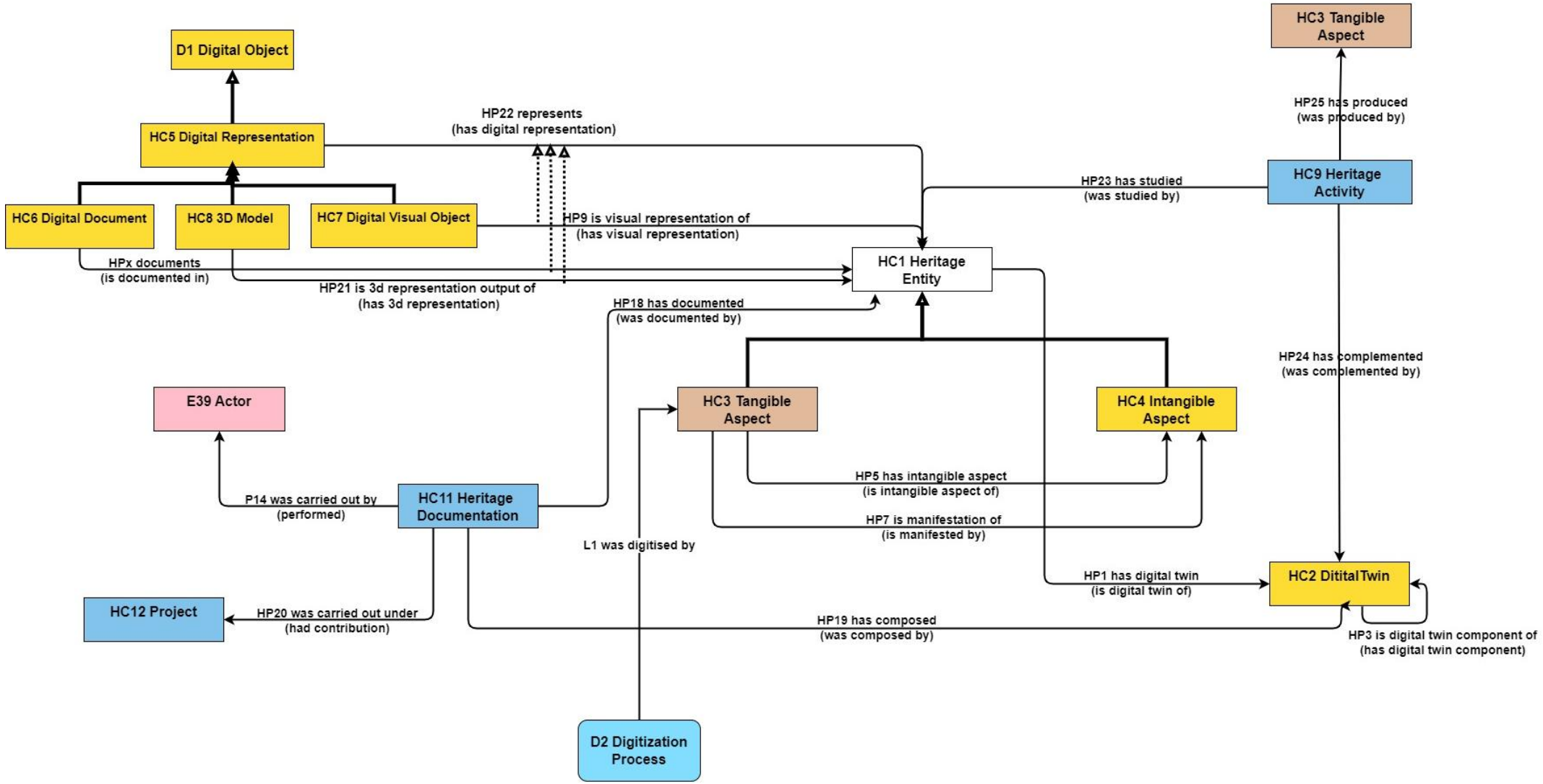

Heritage Entity
HC1
Heritage Digital
Twin
HC2
Has a set of formal
propositions based on
The identity of HC2 as
defined by an authority group
Inferences
Statements
Evidence-based
Synthetic
Prior knowledge
Observations
References
Indirect
Direct
IOT
Workflows
Data

HC3 Tangible Aspect

The **HC3 Tangible Aspect** class comprises tangible, material entities of the real-world, both movable (e.g. archaeological, artistic and cultural objects) and immovable (e.g., built heritage like monuments, buildings, cities and other complexes), regarded as valuable because of their contribution to society, knowledge and/or culture. The “tangible” term in the name of this class does not exclude that its instances also possess an intangible aspect, which is specified through the HP5 has intangible aspect property.

Subclass of: HC1 Heritage Entity and crm:E18 Physical Thing

HC3 Tangible Aspect

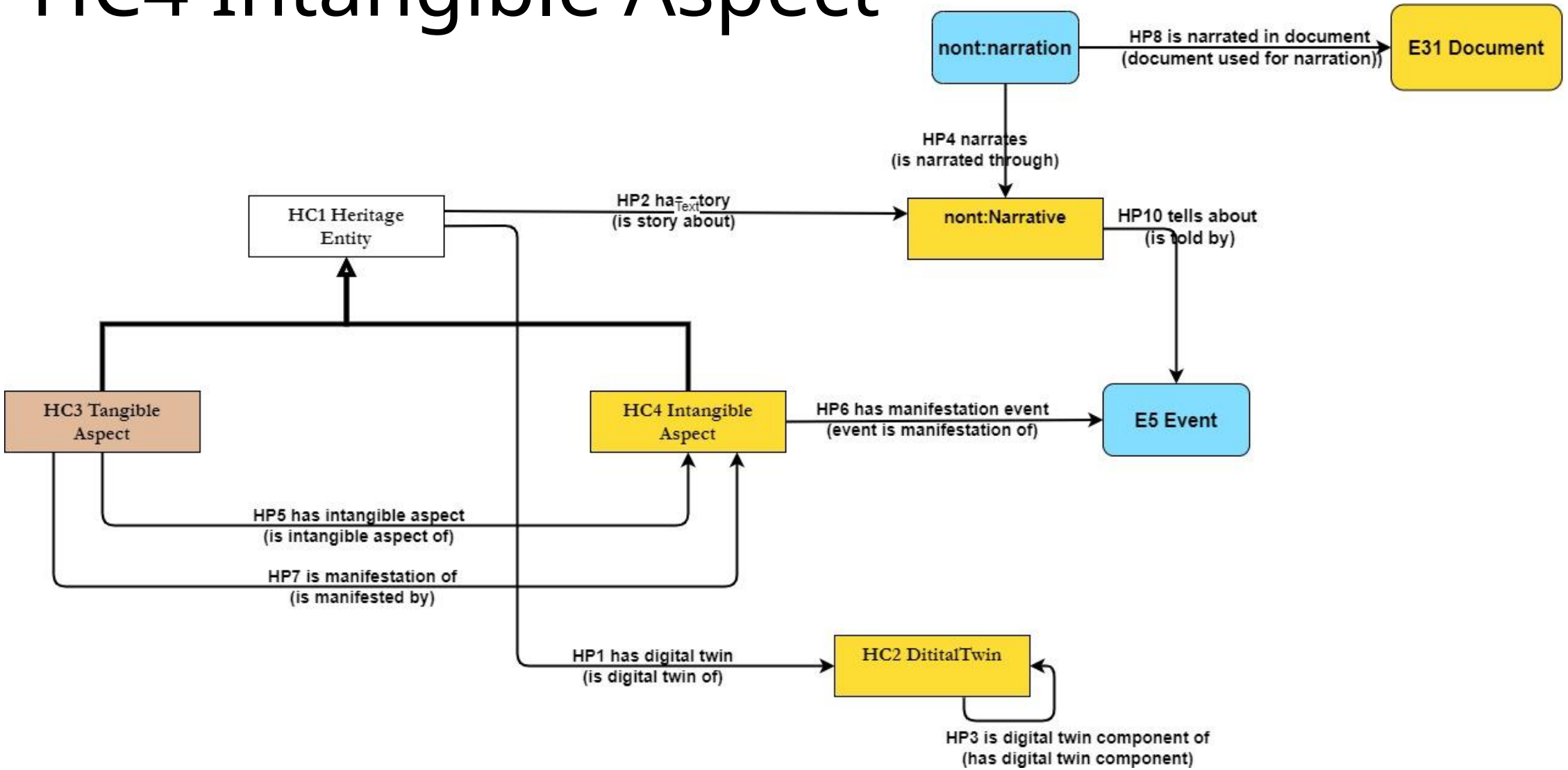


HC4 Intangible Aspect

The **HC4 Intangible Aspect** class comprises expressions and declarations of cultural events, traditions and practices having particular social, historical and cultural significance, including practices and expressions, memories and oral traditions about events, things, people. An Intangible Aspect is identified by a society or by evidence or other kind of manifestations. The identity of an Intangible Aspect results from an agreement and a validation made by a group of people for a specific time-span.

Subclass of: HC1 Heritage Entity and crm:E89 Propositional Object

HC4 Intangible Aspect



Thank you for your attention!

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