

Object Biographies as Bridge Between Heterogeneous Research Data



NFDI4OBJECTS

Research Data Infrastructure
for the Material Remains of
Human History

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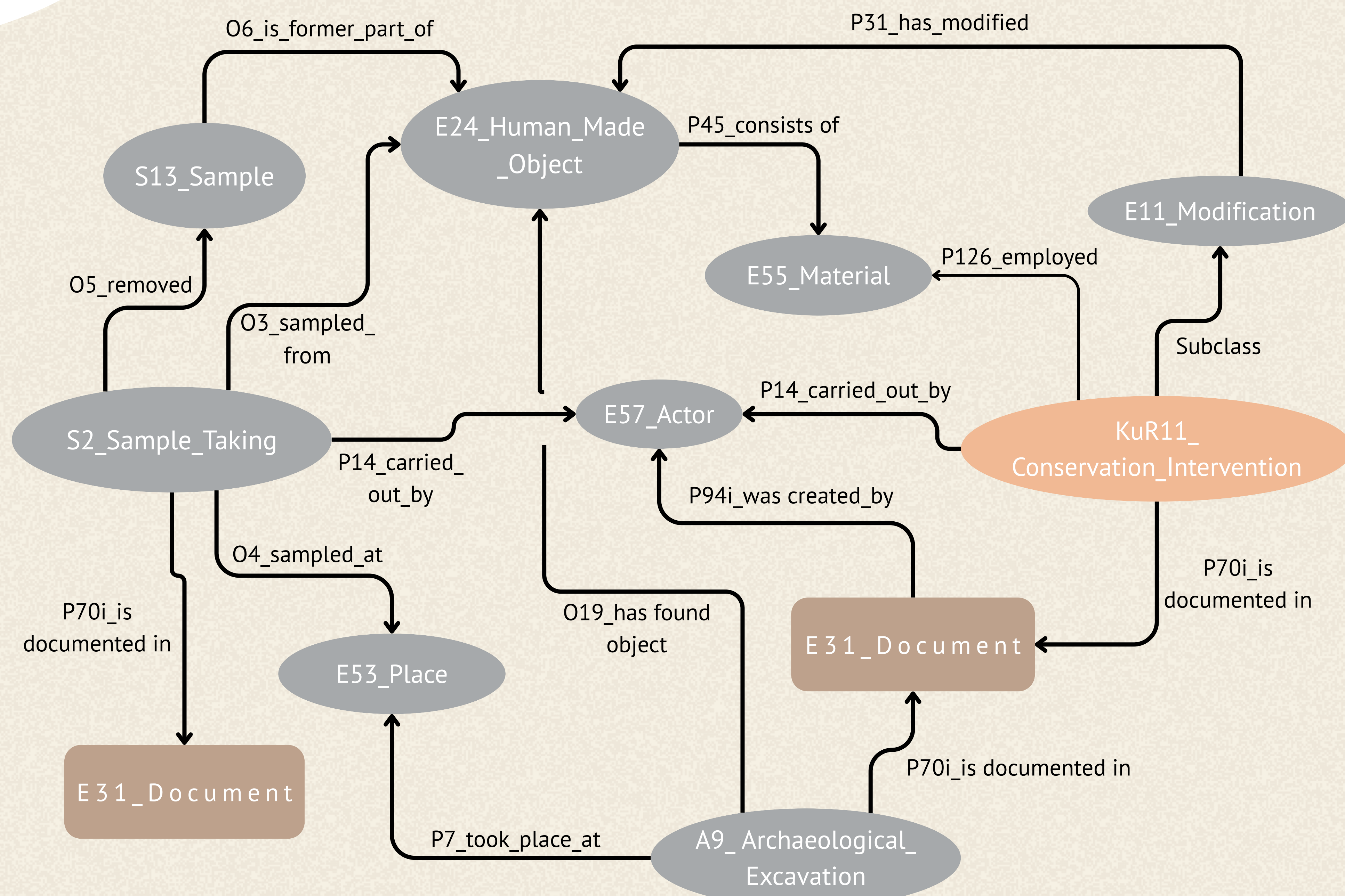
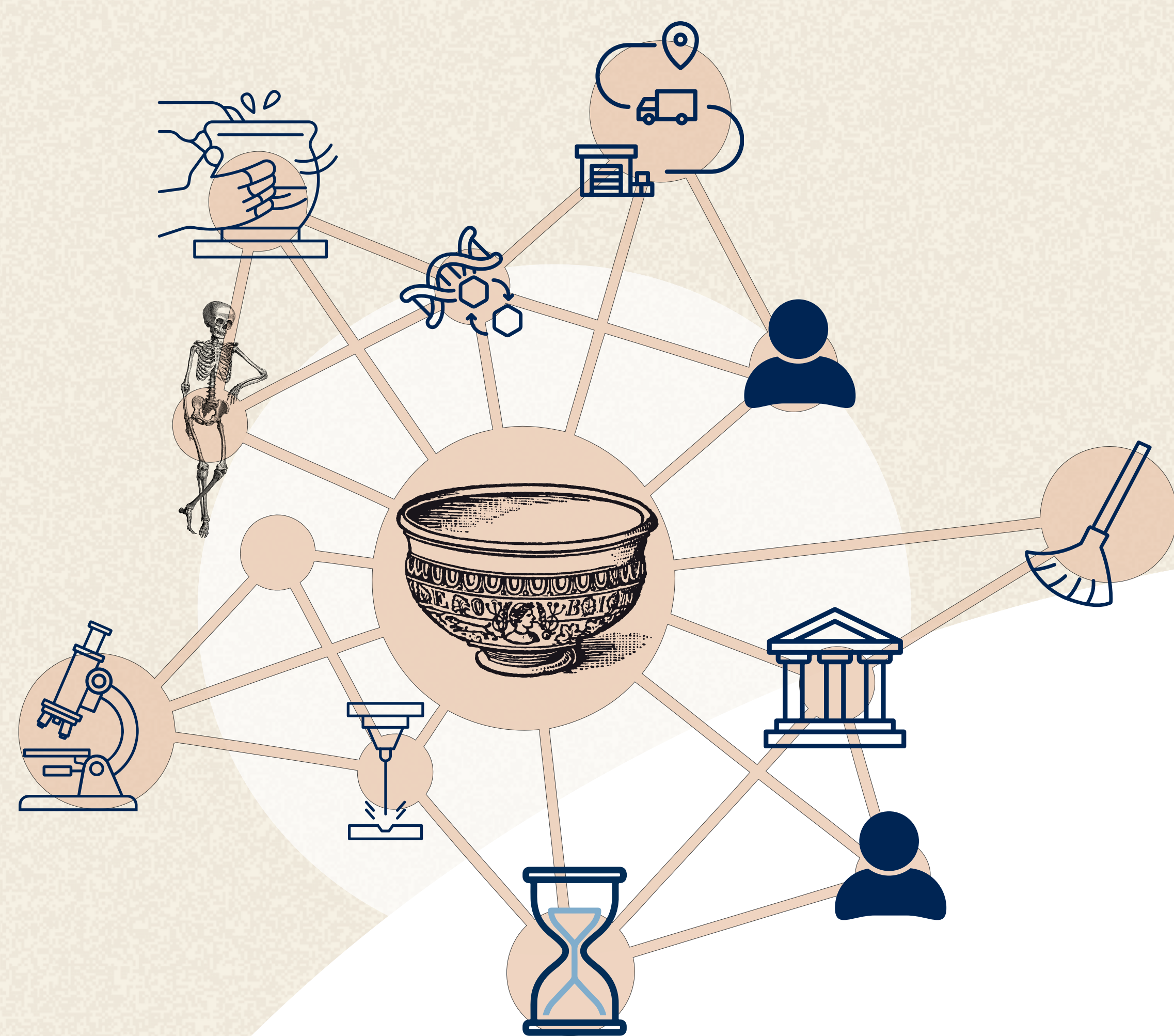
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Heterogeneous Data within Heritage Science

The study of material cultural heritage unites a broad range of scientific disciplines, from **archaeology**, **archaeometry** and **anthropology**, to **numismatics**, **conservation science**, and **provenance research**. This diversity reflects the many perspectives from which material objects yield information about **past societies**, **material compositions**, **trade networks**, and **ownership histories**. Each discipline approaches the object from a different angle, focuses on **different stages of its history**, and, through new activities on or with the object, such as analysis or conservation treatment, actively generates **new events in the objects life**.

Each of these disciplines generates **highly heterogeneous data**, which is characterised by **different terminologies**, **data structures** and **formats**. This heterogeneity poses a fundamental challenge for interdisciplinary research. Without shared standards, data remains confined to the context in which it was created, interpretable only within its own disciplinary silo. Yet it is precisely the contextualisation of data across different perspectives that **unlocks new insights** and may give **rise to research questions** that were entirely unforeseen at the time of data collection. As **computational methods** and **artificial intelligence** play an increasingly prominent role in humanities research, the demand for **standardised, machine-readable data** is growing accordingly.



The NFDI4Objects Infrastructure

Cultural heritage objects were made, used, exchanged, repaired, lost, rediscovered, conserved, and researched. Each of these stages constitutes an **event**, involving **actors**, **places**, and **time periods**, and generating sources, e.g. **written records**, **images** or **analytical data**. Transferring the concept of biography to material cultural heritage provides a powerful framework for capturing and connecting this complexity across an object's entire lifespan.

The consortium **NFDI4Objects** translates this concept into a **shared infrastructure** based on **Linked Open Data principles**. At its core is the **N40 Object Core Metadata Profile**, which acts as a semantic bridge between domain-specific metadata standards, such as the conservation metadata schema, the minimum dataset recommendations for museums, or requirements from provenance research, and broader metadata ecosystems.

A key outcome has been the identification of harmonisation potentials and gaps in existing schemas, with derived mappings currently being validated and collaboratively refined through iterative community processes.

The **Material Cultural Heritage Crosswalk Ontology** complements this by mapping heterogeneous data models from different disciplinary communities to the **CIDOC Conceptual Reference Model (CRM)** as a top-level ontology, with **Lightweight Information Describing Objects (LIDO)** serving as the underlying **XML metadata format**. These components converge in the **N40 Knowledge Graph**, the central integration layer of the infrastructure. It draws on published research data from repositories and openly accessible databases and connects it into a unified graph structure.

Data originally created in isolation, by different institutions, in different formats, for different purposes, can suddenly be **queried together**. An object from a museum database can be linked to excavation records, material analyses, and authority files, enabling research questions that would simply not have been possible when information remained scattered across disconnected systems. In this way, **the Knowledge Graph gives digital form to the object biography**. By semantically connecting data from across disciplines, institutions, and research contexts, it becomes possible to **trace the full history of an object** as a coherent, queryable narrative rather than a collection of isolated records.



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