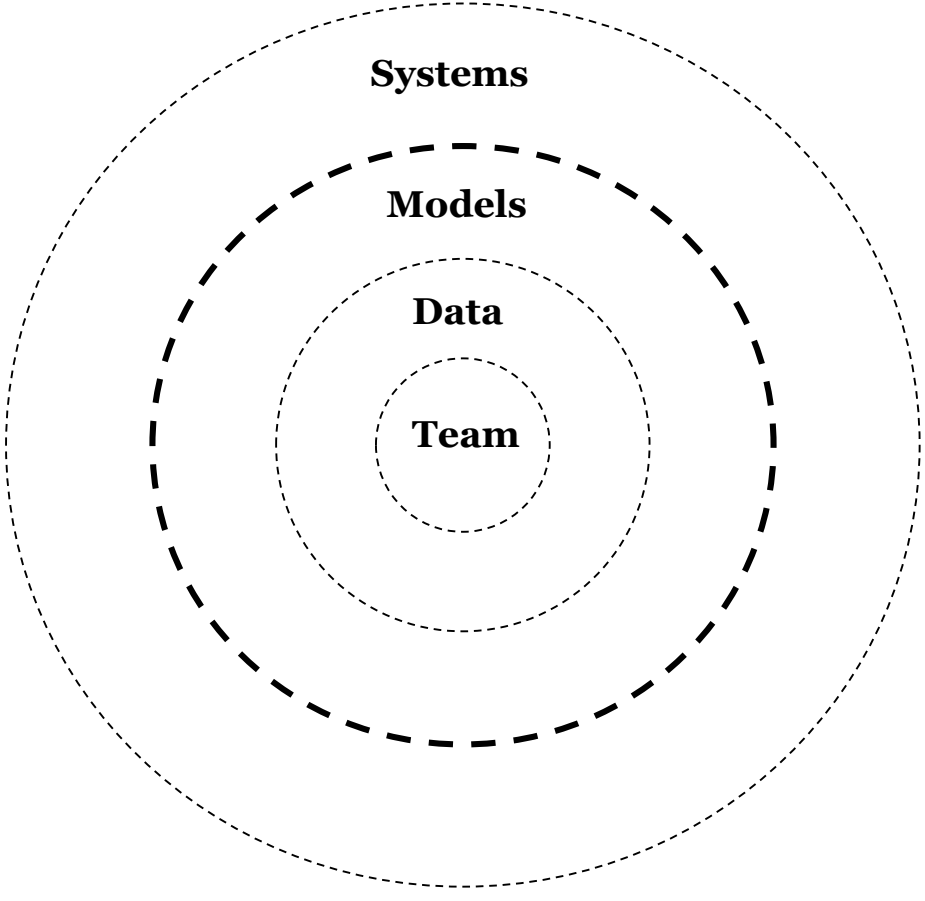
King's Digital Lab

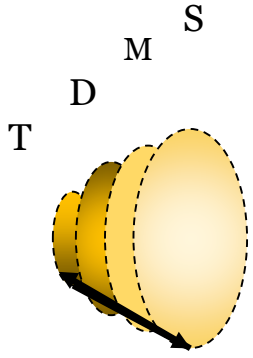
KING'S College LONDON

Digital researchers and data experts

We create digital tools to explore academic research in new ways.

DATA MODELLING

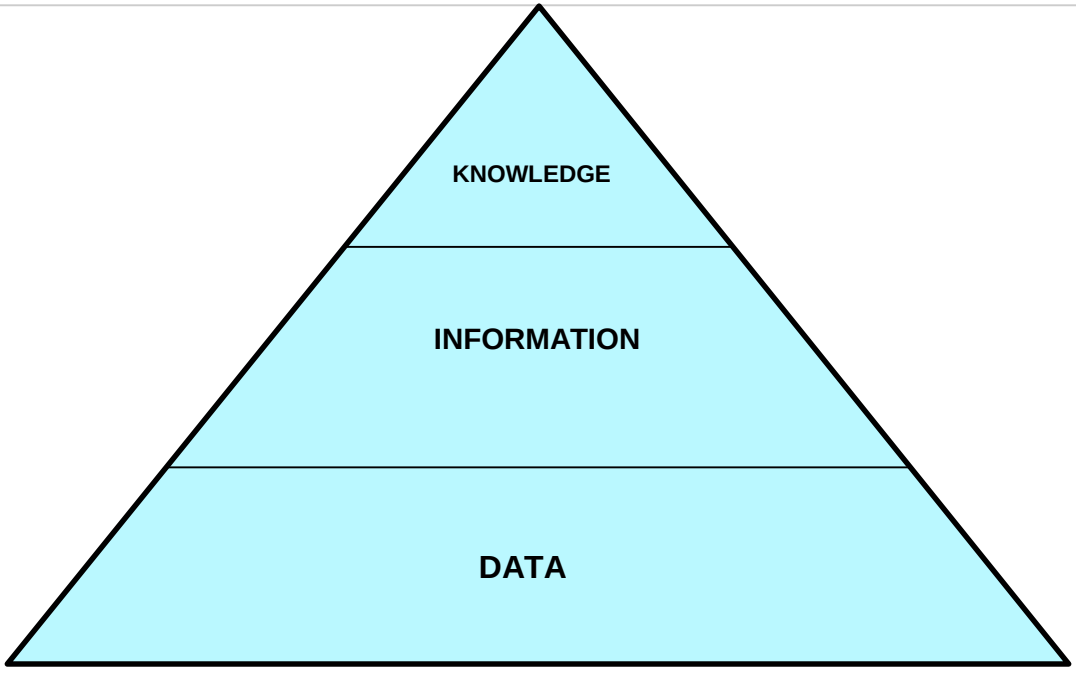




Co-constitution (biodirectional influence & dependencies)

Ciula and Smithies (forthcoming), Sustainability and modelling at King's Digital Lab.

Data Information Knowledge



On "DIKW hierarchy", see Rowley (2007), "The wisdom hierarchy: representations of DIKW hierarchy".
See also Knowledge Management Tools (2010-2018), "Defining Knowledge, Information, Data".

The rest of the slides in this section are adapted from Ciula and Tupman (2016), Session 7: Ontologies and Data Modelling.
See also Eide and Ore (2018), Ontologies and Data Modelling.

Data Models and Ontologies

Data Model Formalized description of how to organize data in an information system

Ontologies Special kind of data models

"An ontology is an explicit specification of a conceptualization. The term is borrowed from philosophy, where an ontology is a systematic account of Existence. For AI [Artificial Intelligence] systems, what "exists" is that which can be represented."

Gruber (1993), A Translation Approach to Portable Ontology Specifications.

What is an Ontology?

Conceptualization

Explicit

Specific knowledge domain / limited scope

Realist vs pragmatic (see Pasin and Ciula (2009), Laying the Conceptual Foundations)

- Metaphor → agreement - contract - compromise

Form

- Scope notes + examples + connections to other concepts
- Comparisons and extensions with other models

'Ontological' Analysis

Components

- Access to expert knowledge
- Analysis (BEFORE formal description) → role of examples
- Formal translation → generalize examples
- Documentation
- Implementation (data storage)

Understand domain and specify basic properties

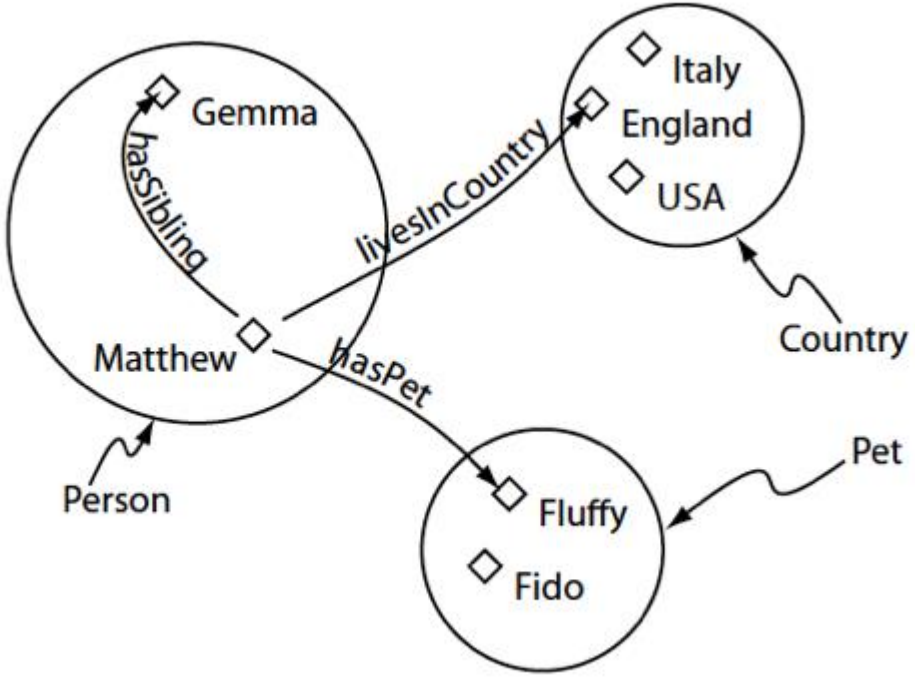
Classes and Properties

Class

- Universal
- Functional concept
- Recall vs precision
- Intension vs extension

Property

- Class level
- Interconnection of entities



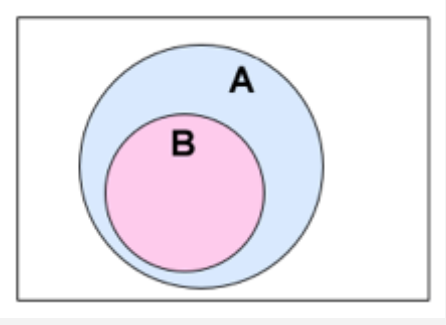
http://mowl-power.cs.man.ac.uk/protegeowltutorial/resources/ProtegeOWLTutorialP4_v1_3.pdf

Horridge (2011), A Practical Guide To Building OWL Ontologies Using Protéé 4 and CO-ODE Tools Edition 1.3 (p. 11).

- Formal structure vs interpretation
- Ontology commitment vs formal restriction
- Ontology definition → formal definition + scope notes + examples

Structure

- Object oriented
- Set of classes + properties
- Hierarchies and inheritance



First Order Logic

Resource Description Framework (RDF) → Linked Data

- Uniform Resource Identifier (URI)
- Triple = Subject (node) + Predicate (property) + Object (node)
- SPARQL
- Directed graph
- RDFS
- Web Ontology Language (OWL) → Semantic reasoning

Ontologies in the Humanities and Cultural Heritage

Encode meaning

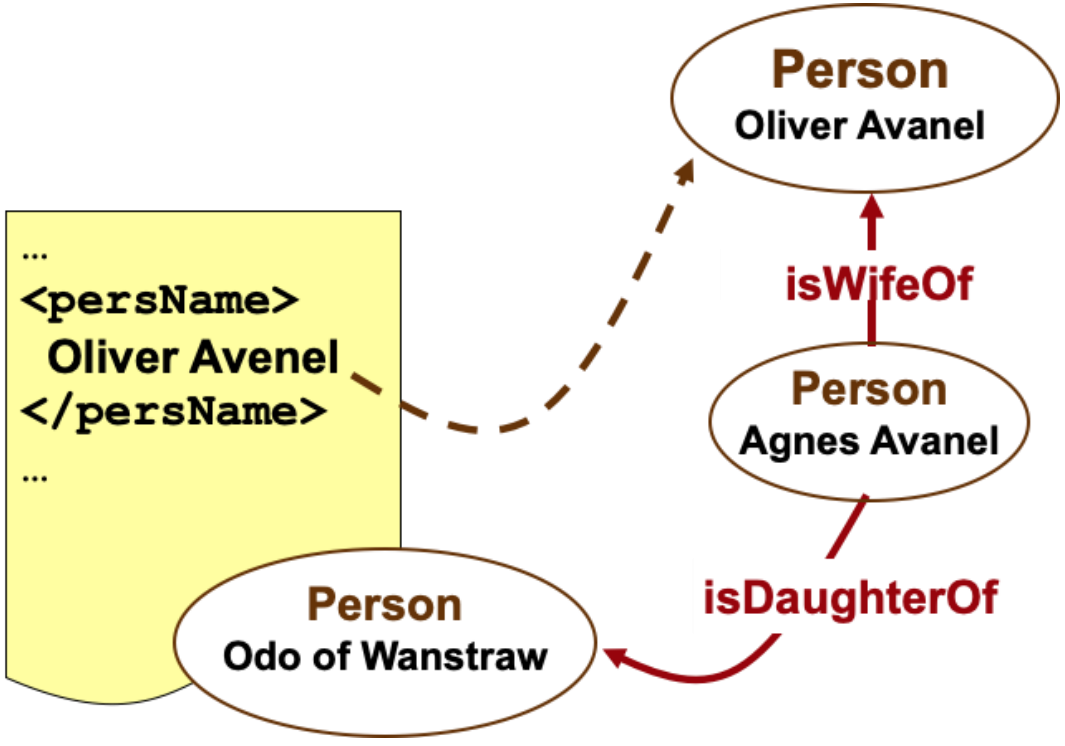
Novel ways to integrate and re-use

Risk of oversimplification

Digital Cultural Heritage

- From texts (to describe or refer to non-textual resources) to relational statements connecting entities (e.g. artefacts, places, people, events)

Henry III Fine Rolls

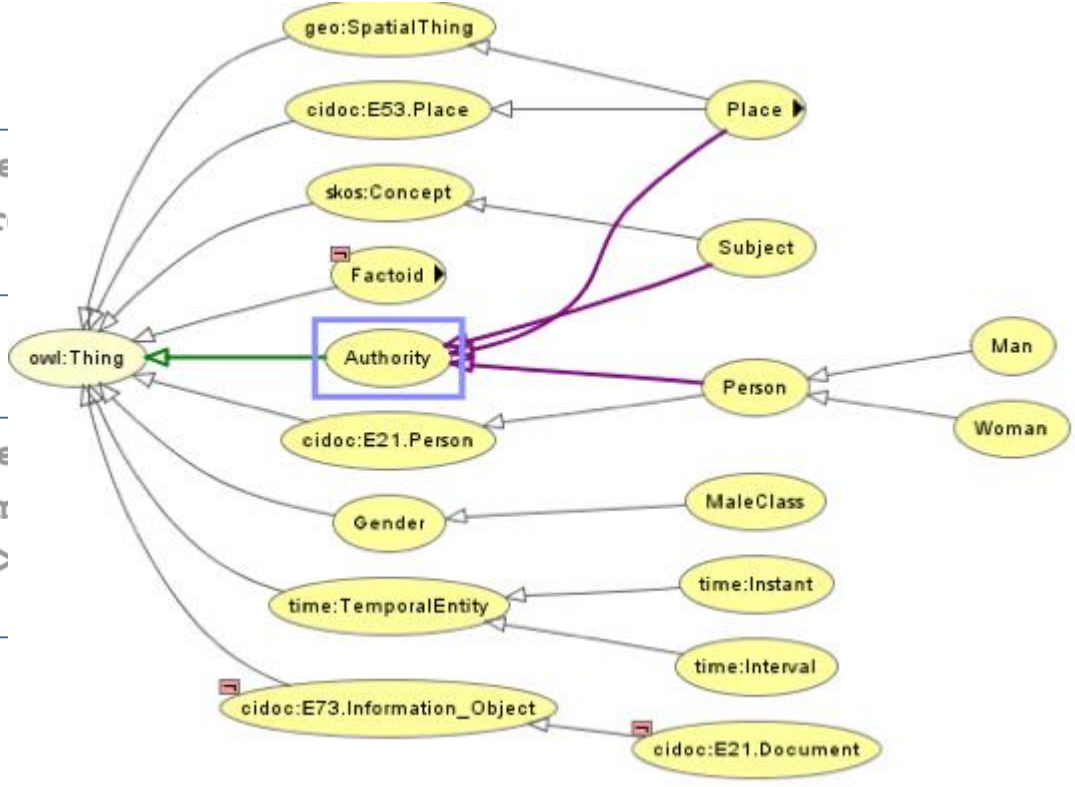


Example from the Henry III Fine Rolls Project

Henry III Fine Rolls

```
<persName key="ashford_de
   <placeName key="ashfor
</persName>
```

```
<rs key="abjuration" type
kingdom<persName key="rum
<placeNamekey="rumberue">
s>
```

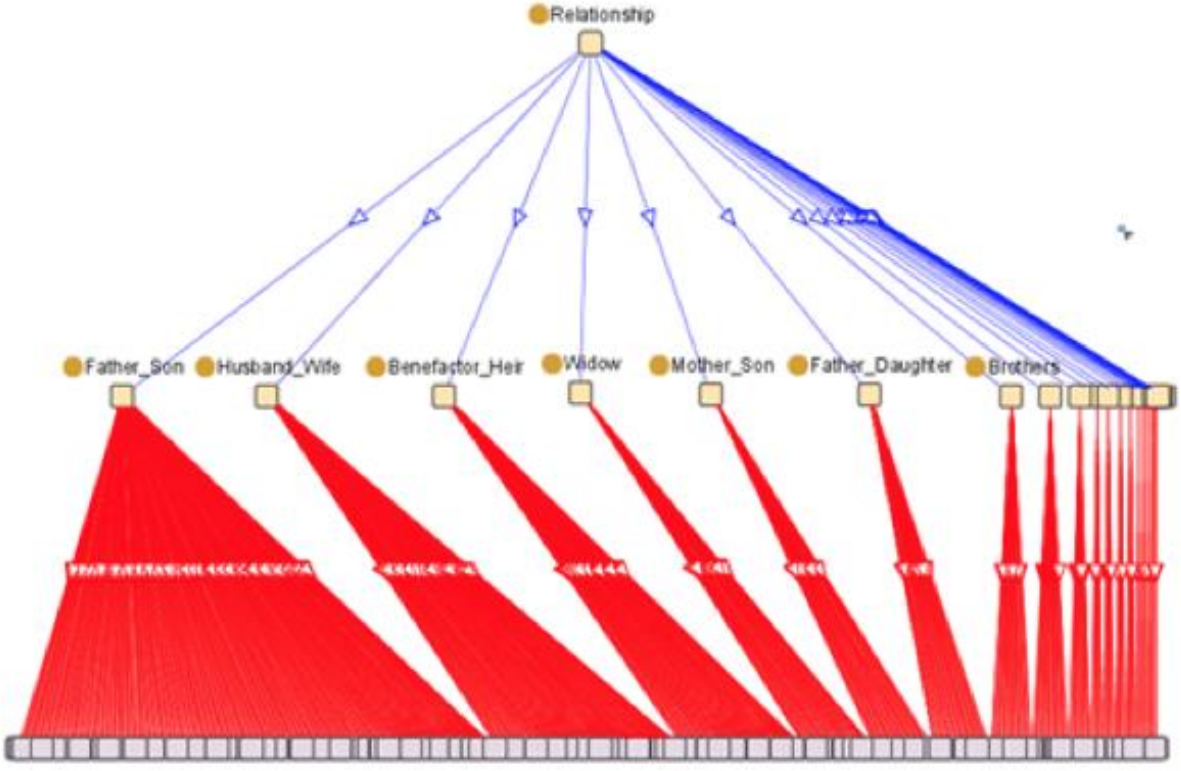


Example from the Henry III Fine Rolls Project

Henry III Fine Rolls

```
<persName key="ashf
   <placeName key="a
</persName>
```

```
<rs key="abjuration
kingdom<persName ke
<placeNamekey="rumb
s>
```



Example from the Henry III Fine Rolls Project

CIDOC-CRM

International Committee for Documentation (CIDOC) of the International Council of Museums (ICOM) Conceptual Reference Model http://www.cidoc-crm.org/

- ISO standard ISO 21127:2006
- Museums, Libraries, Archives
- CIDOC CRM SIG

Event-centric core ontology

From museums documentation systems to wider application

Combined with other ontologies

CIDOC-CRM

Event-centric

- + thing, place, person, conceptual object
- Model museum object in context

Appellations

Types

...

Sub and super-classes

Scope-notes

Examples

Properties (domain, range ...)

Some graphical representations

CIDOC-CRM

E53 Place

Subclass of: E1 CRM Entity

Scope note: This class comprises extents in space, in particular on the surface of the earth, in the pure sense of physics: independent from temporal phenomena and matter.

The instances of E53 Place are usually determined by reference to the position of "immobile" objects such as buildings, cities, mountains, rivers, or dedicated geodetic marks. A Place can be determined by combining a frame of reference and a location with respect to this frame. It may be identified by one or more instances of E44 Place Appellation.

It is sometimes argued that instances of E53 Place are best identified by global coordinates or absolute reference systems. However, relative references are often more relevant in the context of cultural documentation and tend to be more precise. In particular, we are often interested in position in relation to large, mobile objects, such as ships. For example, the Place at which Nelson died is known with reference to a large mobile object – H.M.S Victory. A resolution of this Place in terms of absolute coordinates would require knowledge of the movements of the vessel and the precise time of death, either of which may be revised, and the result would lack historical and cultural relevance.

Any object can serve as a frame of reference for E53 Place determination. The model foresees the notion of a "section" of an E19 Physical Object as a valid E53 Place determination.

Examples:

- the extent of the UK in the year 2003
- the position of the hallmark on the inside of my wedding ring
- the place referred to in the phrase: "Fish collected at three miles north of the confluence of the Arve and the Rhone"
- here -> <-

In First Order Logic:

$$E53(x) \supset E1(x)$$

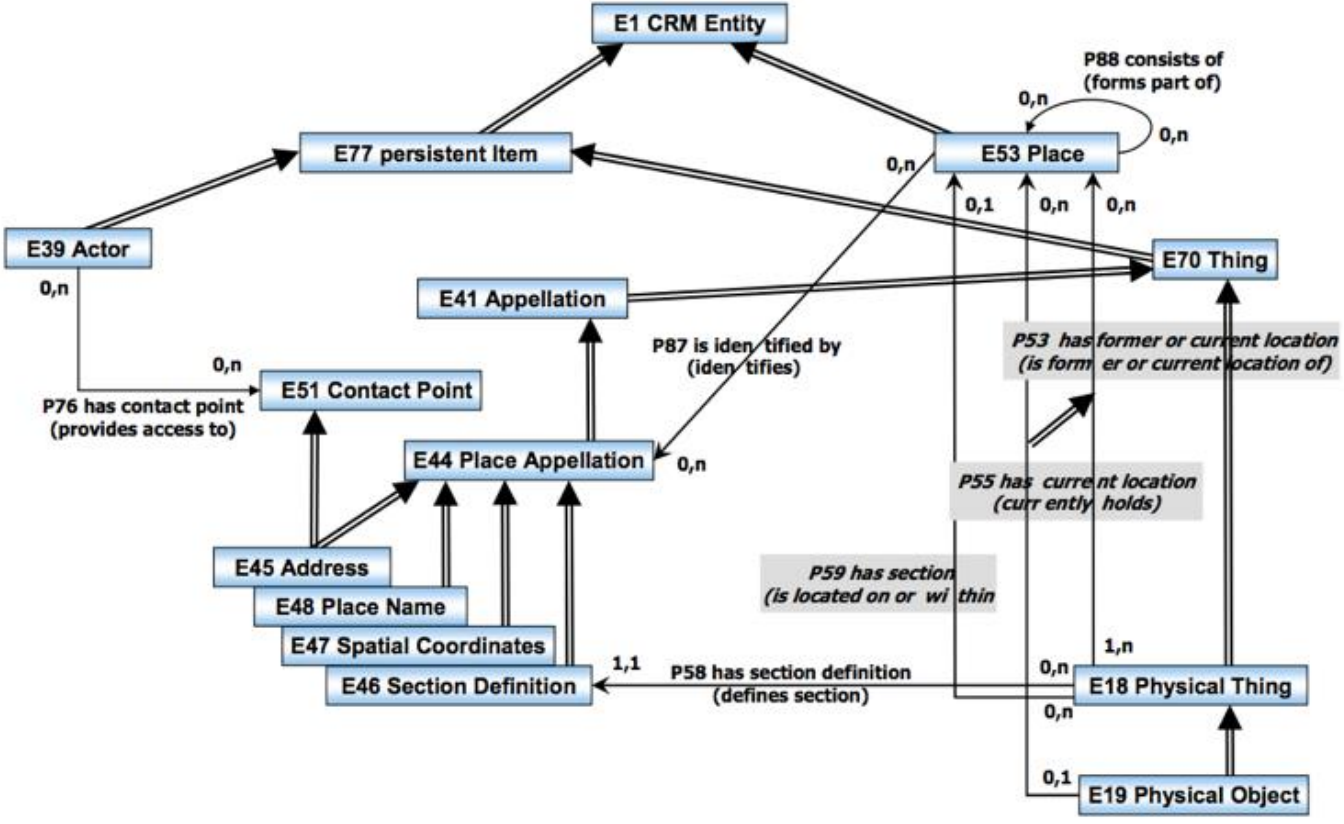
Properties:

P87 is identified by (identifies): E44 Place Appellation
P89 falls within (contains): E53 Place
P121 overlaps with: E53 Place
P122 borders with: E53 Place
P157 is at rest relative to (provides reference space for): E18 Physical Thing
P168 place is defined by (defines place) : E94 Space Primitive

CIDOC-CRM

```
<rdfs:Class rdf:about="E53_Place">
    <rdfs:label xml:lang="it">Posto</rdfs:label>
    <rdfs:label xml:lang="fr">Place</rdfs:label>
    <rdfs:label xml:lang="en">Place</rdfs:label>
    ....
    <rdfs:comment xml:lang=”en”>This class comprises extents in
    space […] place determination.</rdfs:comment>
    <rdfs:comment xml:lang=”it”>Questa classe comprende
    estensioni spaziali […] determinazione posto.
    </rdfs:comment>
    <rdfs:subClassOf rdf:resource="E1_Enityt"/>
</rdfs:Class>
```

CIDOC-CRM


E1 CRM Entity
P88 consists of
(forms part of)
0,n
0,n
E77 persistent Item
E53 Place
0,n
0,1
0,n
0,n
E39 Actor
E70 Thing
0,n
E41 Appellation
P87 is iden tified by
(iden tifies)
P53 has former or current location
(is form er or current location of)
0,n
E51 Contact Point
P76 has contact point
(provides access to)
E44 Place Appellation
0,n
P55 has current location
(curr ently holds)
E45 Address
P59 has section
(is located on or wi thin
E48 Place Name
E47 Spatial Coordinates
1,1
P58 has section definition
(defines section)
0,n
1,n
E46 Section Definition
E18 Physical Thing
0,n
0,1
E19 Physical Object

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We create digital tools to explore academic research in new ways.

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DIGITAL COLLECTIONS at the BRITISH MUSEUM