Supporting Documentation at the Categorical Level

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Categorical Documentation
Outline

- Problem statement – diversity of interest
- Reality and knowledge representation
- Factual and categorical knowledge
- Metaproperties for the CRM
- Conclusion

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Problem Statement

- Current data structures are made to organize description of facts (particulars) by providing a system of classes (nodes, tables) and relationships (attributes, links).
- No difference is made between data that are particulars and those that are universals. Inheritance of properties due to instantiation or subsumption of universals appearing as data cannot be described.
- Data in manufacturing (spare parts), ethnography, natural history and others have this problem.
- Few work in knowledge representation about metamodels and their relations to simple models.
- Missing: A theory/proposal of data structures relating particulars and universals – i.e. “cross-categorical data” in a logically well-defined way.

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Problem Statement

- We may be interested in impressionistic paintings influenced by Hokusai.
- We may be interested in paintings from Monet's friends, or paintings presented together at an exhibition.
- We may track an archive to verify circumstances of scientific findings, e.g. which evidence had Linné when he determined some new species?
- We are hardly interested in a dinosaur bone's creator and subject.
- We may be interested in the kind of environment, geographic spread, kind of food of this bone's species.

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"Factual documentation"

- **E.g. Monet's "La Pié"**
  - objects unique and valuable by intrinsic properties

- such as valued art objects, aesthetic minerals, exceptional life forms, curiosities.
- Documentation focus is "Factual on the object":

  contents: form and specific references,
  context of creation to interpret the product:
  influence, social / physical factors,
  history of provenance / prove of authenticity
- Classification serves information selection by analogy, e.g. landscape painting, impressionism etc.

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"Categorical documentation"

- E.g. "Stuffed Fringilla coelebs 1965-0034"

  - objects not unique, with normal production value,

    - used as example out of specific context

- Such as most objects in Natural History, ethnological collections, many archeological objects like frequent types of pottery etc.
- Documentation focus is "representative of its category":

  taxonomic role, deviations from prototype,

  type of context of provenance, of use;
  factual context only a statistical element for induction.
- Classification and categorical behaviour is the information, the object and its context is only an attribute.

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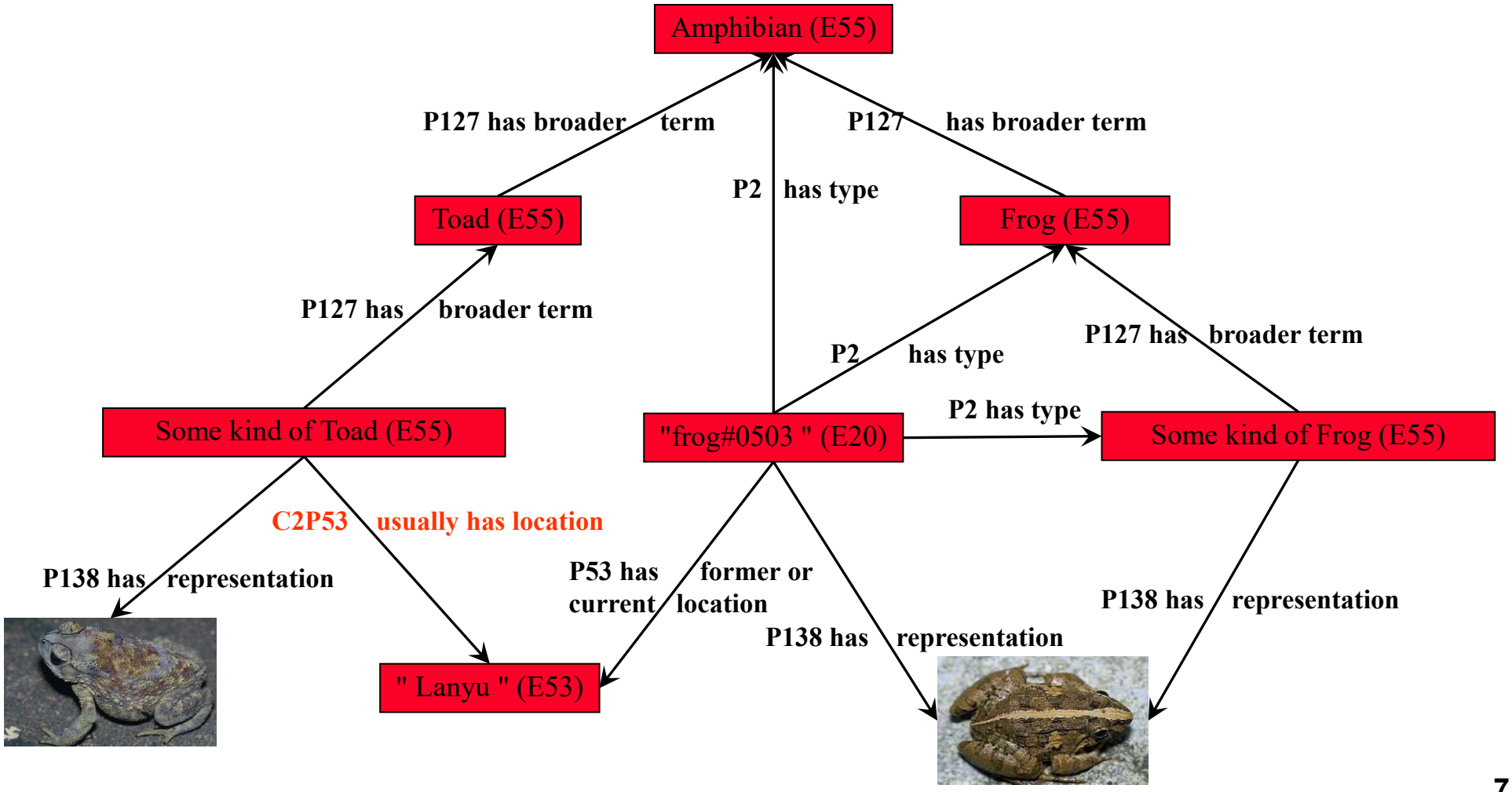
Biological Example (from ChiNan University)



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Ethnological Example (ChiNan University)

Technology Crop (E55)

P138 has representation

P32 used general technique

"Modif.-crop#7901" (E11)

"crop#7901" (E22)

P62 depicts

P108 has produced

P14B performed

"Da-Wu Tribe" (E74)

P14B performed

P74b is current residence of

P138 has representation

"Lanyu" (E53)

P108 has produced

"Prod.-Pottery#035" (E12)

"Pottery#035" (E22)

P62 depicts

P70 is documented in

"Map" (E31)

P138 has representation

P32 used general technique

Technology Tool-Pottery (E55)

P138 has representation

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Instantiation levels

Look at three kinds of knowledge elements:

- factual: “My cat – ate – my mullet” = item- relation – item
- cross-categorical: “My cat –ate - fish” = item- relation – class
- categorical: “cats-eat-fish” = class-relationship-class

- Interpretation of factual statement is unique:

  “the predicate: ate(my cat, my mullet) holds”.

- Interpretation of categorical and cross-categorical statements is not unique.

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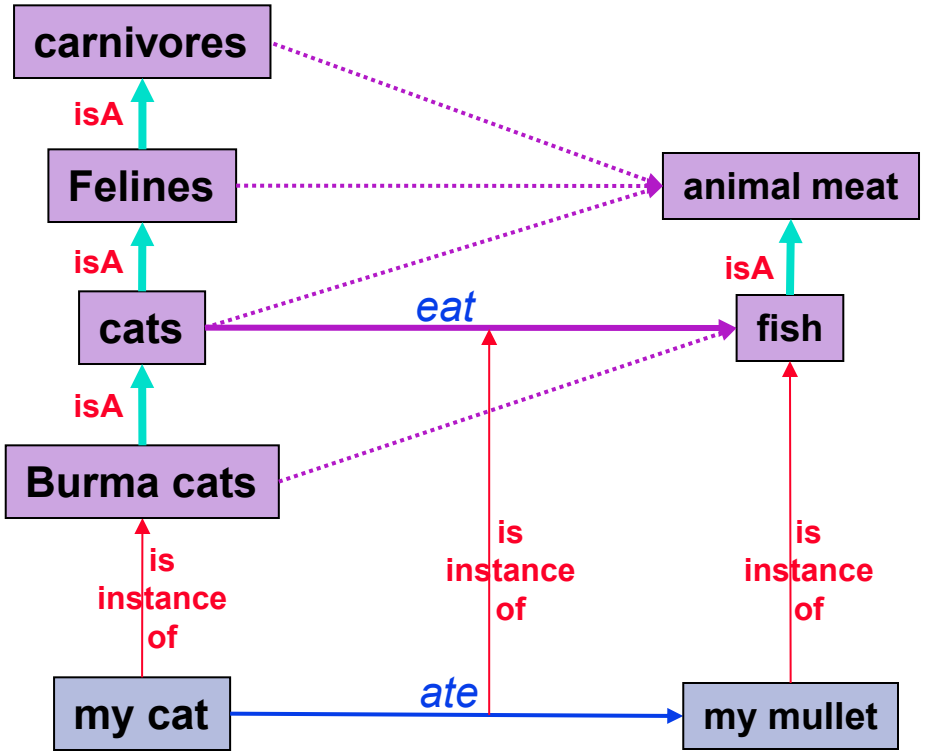
About categorical knowledge



There exist felines/carnivores that eat kinds of animal meat. Fish may be eaten by carnivores

= *All cats eat any fish*

All Birma cats eat any fish

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Interpretation of categorical relationships

- Interpretation of categorical relationships is not unique:

1. eat (Cat,Fish) $\Leftrightarrow$ $\exists$ x:Cat,y:Fish ($\Diamond$ ate(x,y)) = some cats can eat some fish
2. eat (Cat,Fish) $\Leftrightarrow$ $\exists$ x:Cat,y:Fish (ate(x,y)) = some cats have eaten some fish
3. eat (Cat,Fish) $\Leftrightarrow$ $\forall$ x:Cat $\exists$ y:Fish ($\Diamond$ ate(x,y)) = all cats can eat some fish
4. eat (Cat,Fish) $\Leftrightarrow$ $\forall$ x:Cat,$\forall$ y:Fish ($\Diamond$ ate(x,y)) = all cats can eat all fish
5. eat (Cat,Fish) $\Leftrightarrow$ $\forall$ x:Cat (ate(x,y) $\Rightarrow$ Fish(y)) = all cats can eat only fish

* * * * * *

7. card {x: Cat(x) $\wedge$ $\exists$ y $\wedge$ Fish(y) $\wedge$ ate(x,y)} / card {x: Cat(x)} > 0.1 = more than 10% of all cats have eaten some fish.

- Case 1. is the normal meaning of a relationship in a schema and most generic, but normally too week. Frequently, we want to register a typical behaviour, more like case 7.

- We propose : Cat “usually eats” Fish, or Cat “typically eats” Fish.

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Interpretation of cross-categorical rel.

- Interpretation of cross-categorical statements is not unique:
  1. eat kind (mycat,Fish) $\Leftrightarrow \exists$ y:Fish (ate(mycat,y)) = mycat has eaten some fish
  2. eat kind (mycat,Fish) $\Leftrightarrow \forall$ y:Fish (ate(mycat,y)) = mycat has eaten all fish

  * * * * * *

  3. card {y: Fish(y) $\wedge$ ate(mycat,y)} / card {y: ate(mycat,y)} > 0.1 = more than 10% of my cat's food is fish.

- Case 1. is the normal case to denote incomplete knowledge. Case 2. is usual for constraints, such as "Jaguars live in America".

- We propose case 1 as standard meaning. Case 2. is useful to define typologies

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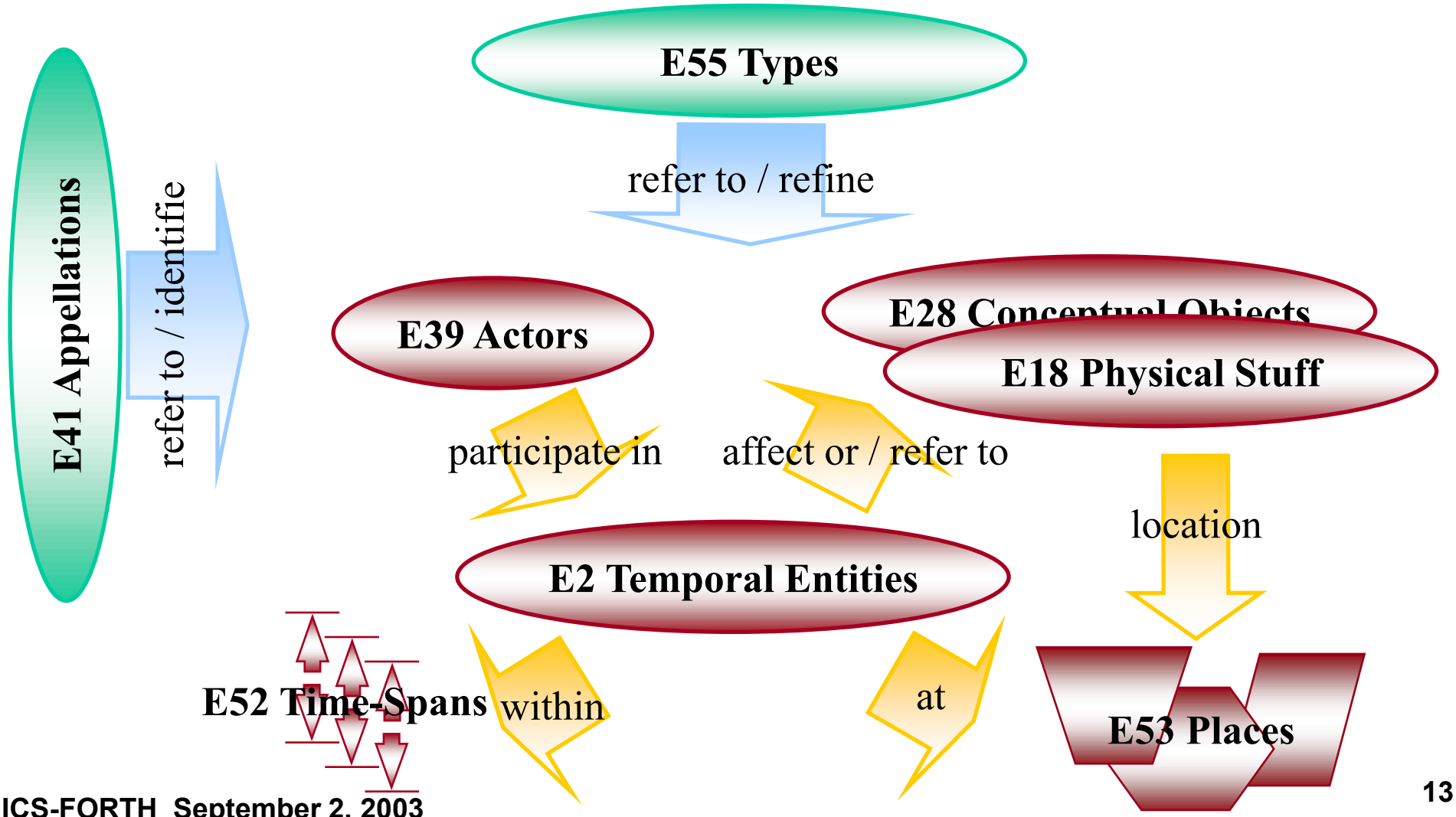
The CIDOC CRM (ISO/CD21127) Top-Level



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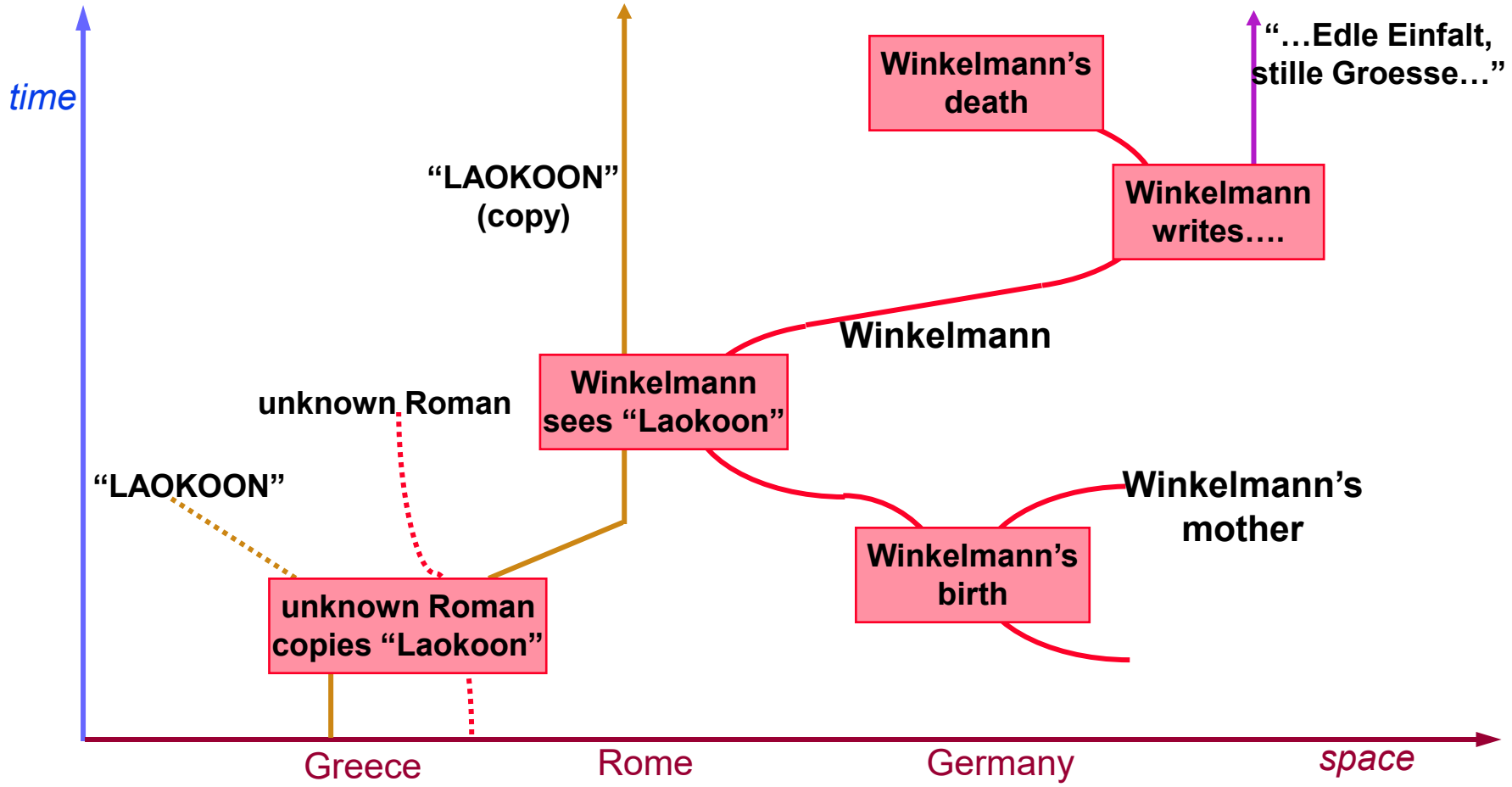
Factual context as a network of "meetings"



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Categorical relationships in the CRM

- *E55 Type* represents a metaclass. All CRM classes can be regarded as instances of *E55 Type*. The property *P2 has type* means *instance-of.*
- *E55 Type* is related by *P127 has broader term,* meaning *IsA*.
- Important cross-categorical relationships are defined, such as: *P125 used object of type,* together with the respective factual one: *P16 used specific object.*
- *E55 Type* is also treated as simple class in the sense of a product of the human mind.
- *There are no other categorical relationships*

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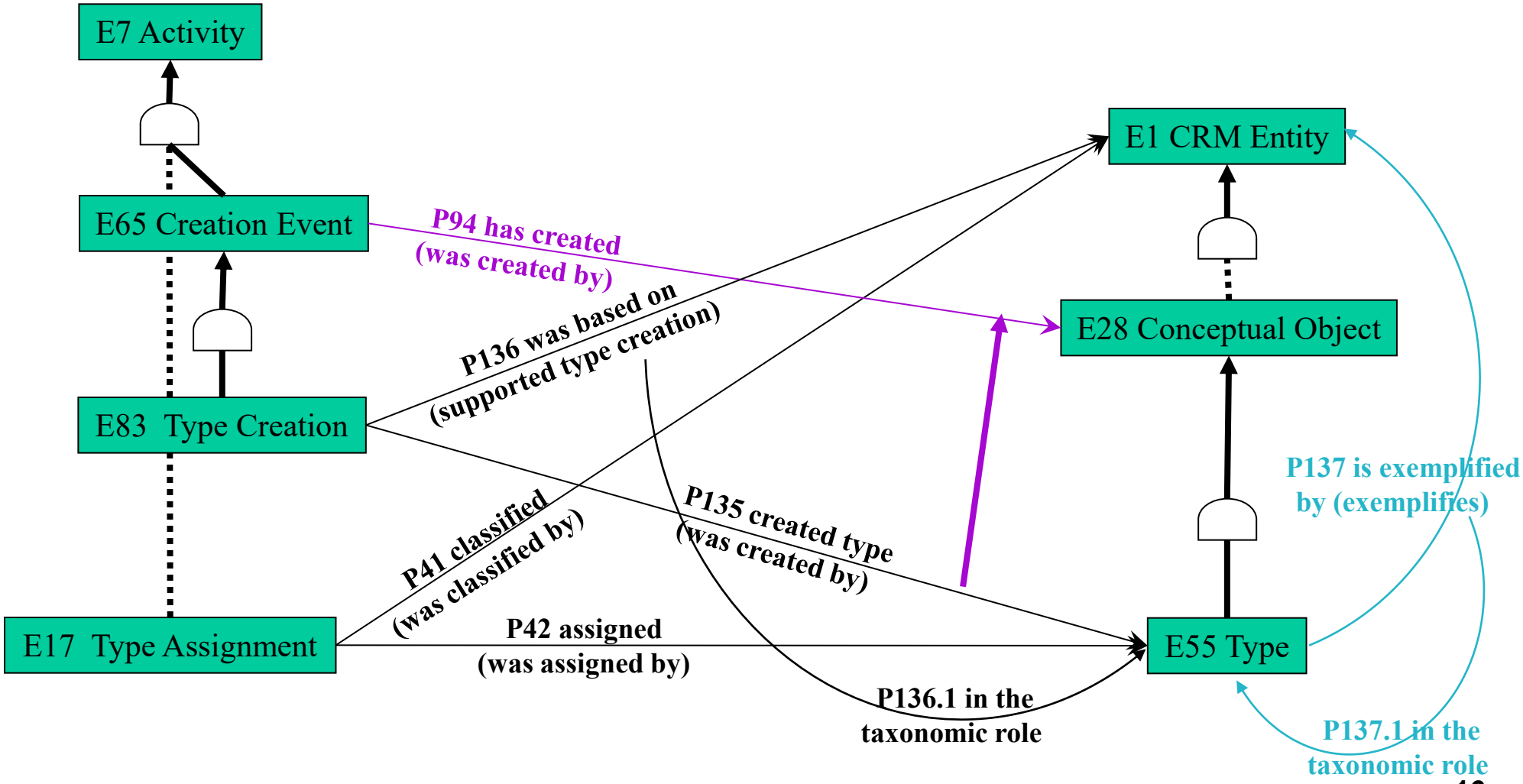
Taxonomic discourse in the CIDOC CRM



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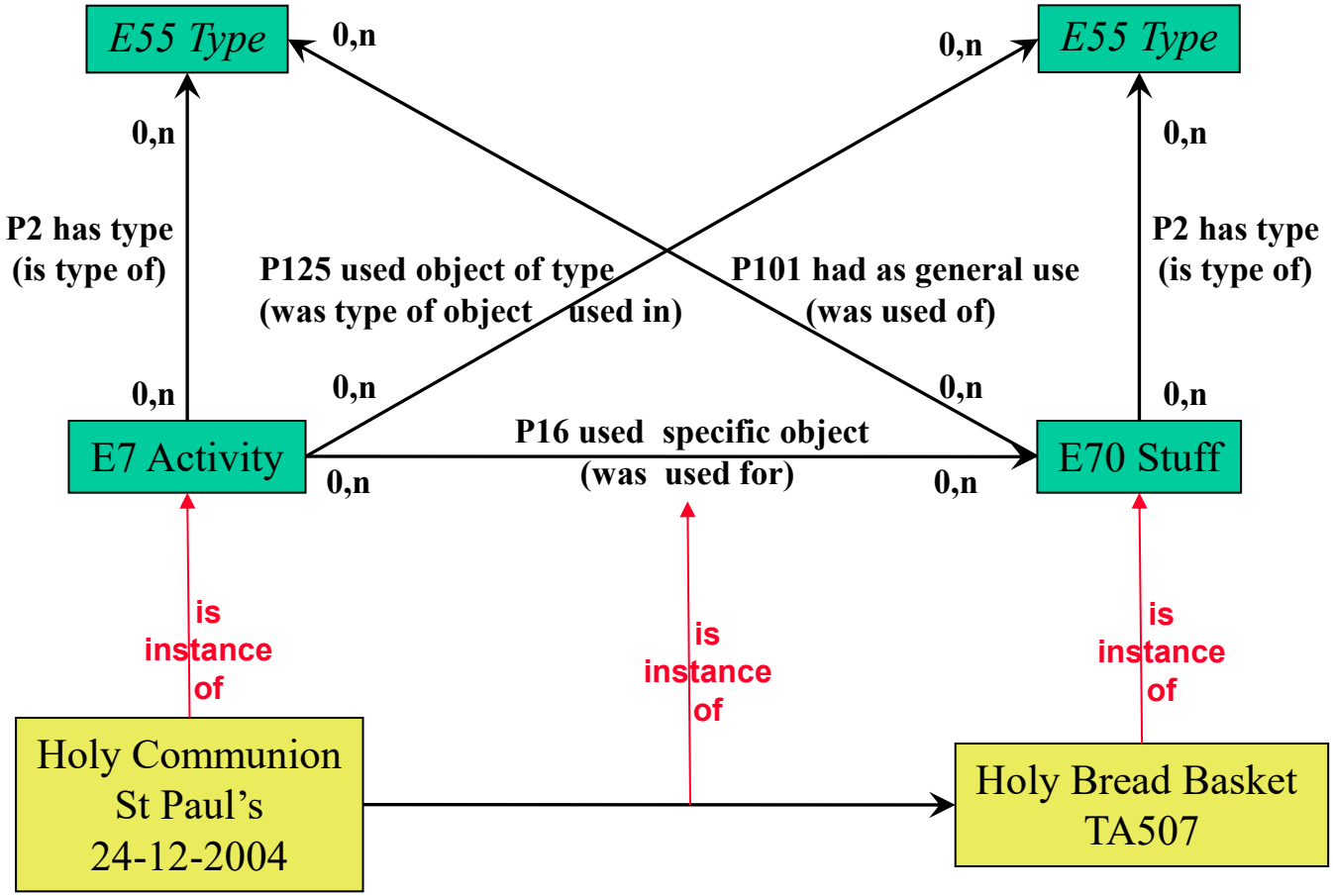
CRM cross-categorial relationships



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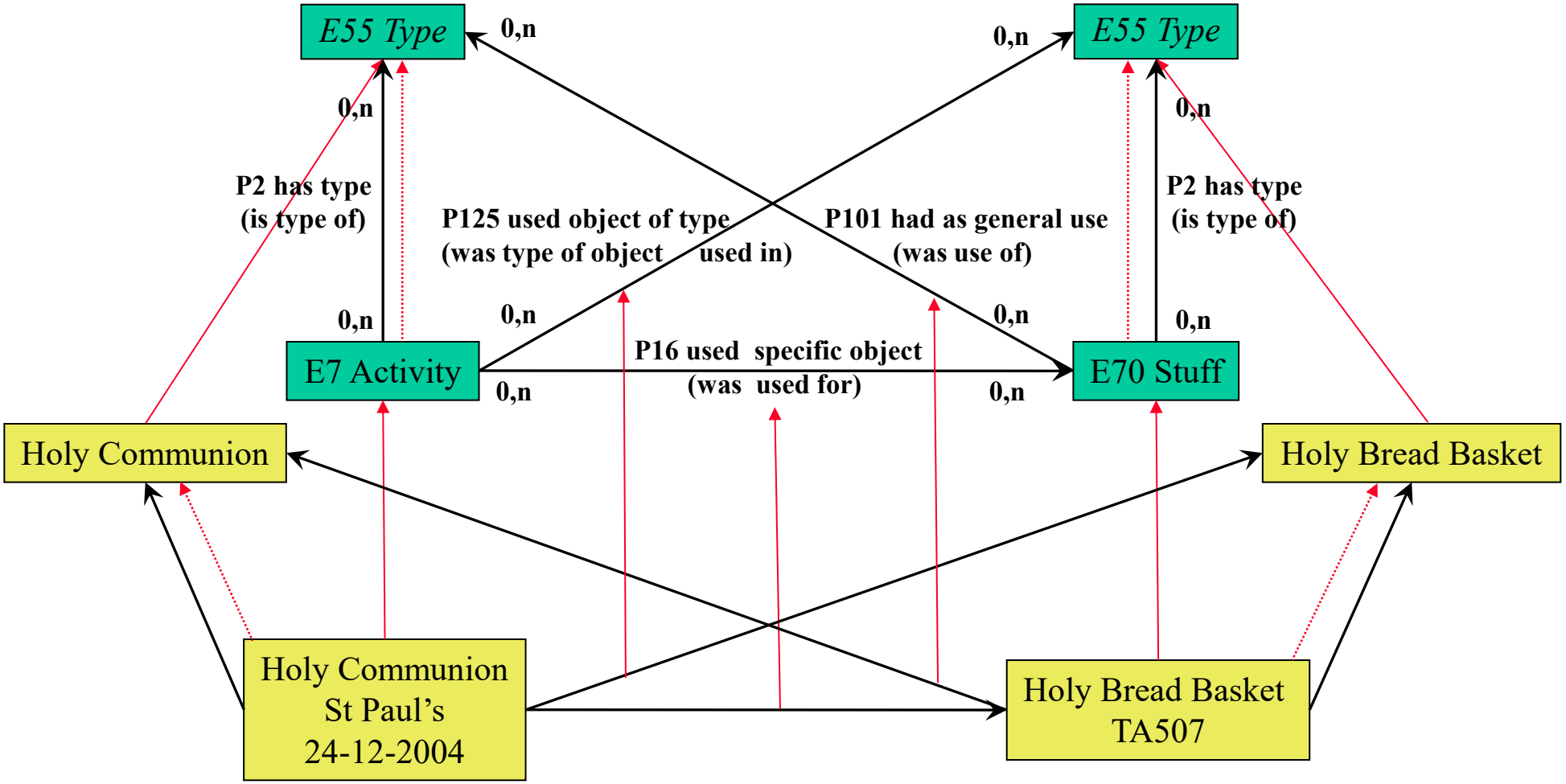
CRM cross-categorial relationships



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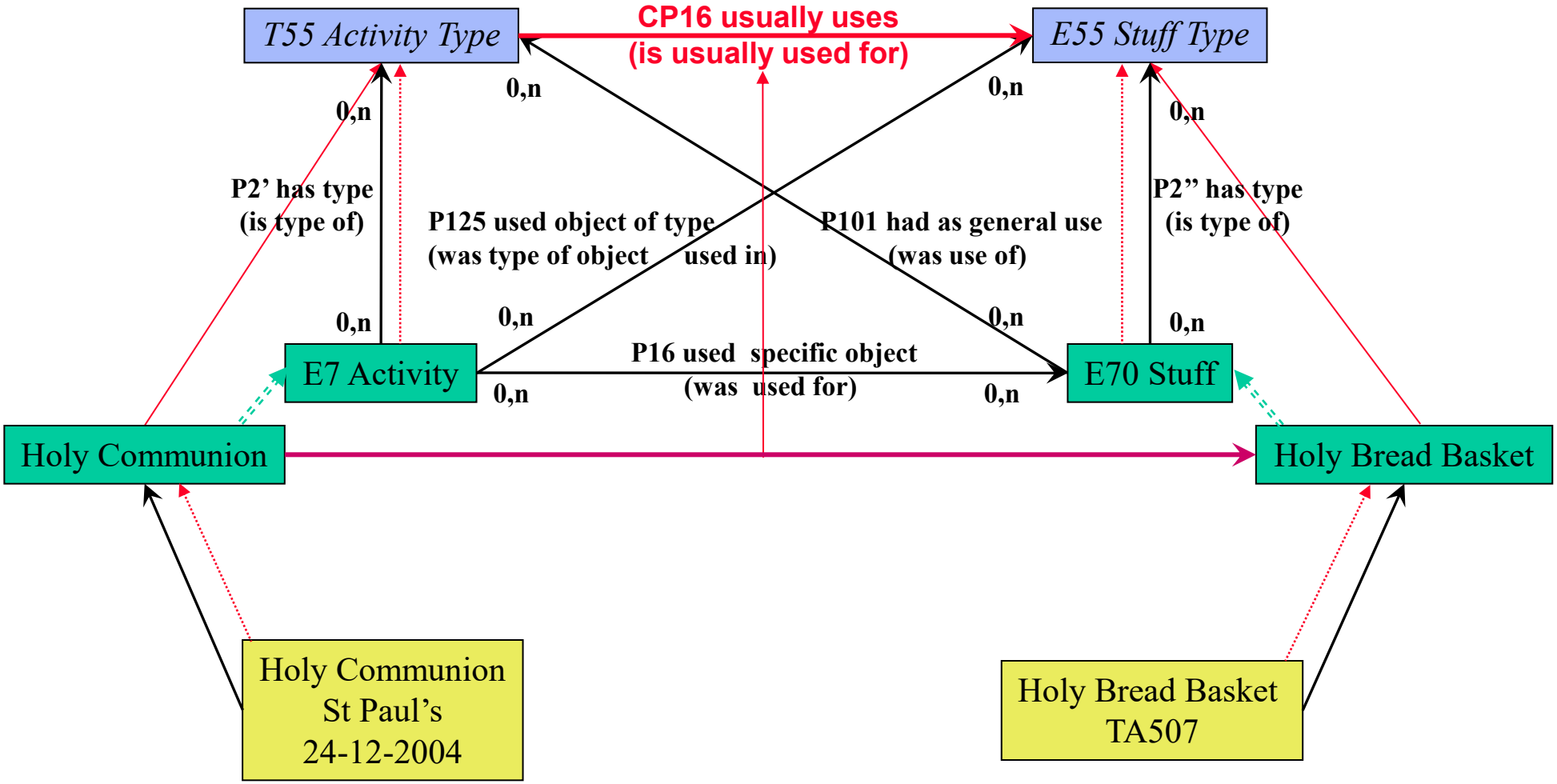
New categorical relationships for the CRM



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The "MetaCRM" proposals

- There seems to be no need for new, more specialized "property verbs". Therefore we propose to generate the categorical and missing cross-categorical properties formally.
- The meaning "usually" seems to be the most important.
- cross-categorical properties should normally mean "there exists an x, instance of C, such that"
- We think of linguistic rules to create appropriate labels:
  - Activity - P16 used object - Stuff
  - Activity - C1P16 used object of type - Stuff Type
  - Activity Type – C2P16 was use of object – Stuff
  - Activity Type – C3P16 usually uses object of type – Stuff Type

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Conclusions

- A “MetaCRM” seems to be appropriate to capture typical categorical statements in museum documentation
- It can be dealt with as application of the CRM not affecting the standard
- The number of relationships becomes huge (about 400). Ideas of practical implementation must be discussed, as well as of new “short-cuts”.
- The notion of “collective events”, such as “Dai Wu pottery making” needs clarification. Is it a particular or a universal? If the latter, do we need to document it as universal?

"People Dress and Shift" (E55)

P138 has representation

P125 used object of type

P131 is identified by

"Da-Wu Tribe" (E74)

"People-T-Shaped" (E55)

P138 has representation

P14B performed

"some Owner Name" (E74)

P125 used object of type

E7 Activity

P125 used object of type

"People-Ornament" (E55)

P138 has representation

P125 used object of type

P2 has type

P2 has type

P2 has type

"People-Hat" (E55)

P138 has representation

"Fishing" (E55)

"Wearing" (E55)

"Graze" (E55)

P125 used object of type

P138 has representation

P138 has representation

"People-Others" (E55)

P138 has representation