



Development of Correlated Ontologies

***Experience with the CIDOC-CRM for Information
Integration in Culture and Science.***

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Correlated Ontologies

Outline

- history of the CRM – conception & rationale
- methodology
- development process and products
- maintenance cycle
- reusing ontologies for new domains
- requirements for maintenance tools



Correlated Ontologies

History of the CIDOC CRM

CIDOC = International Committee for Documentation of the International Council of Museums, an UNESCO organization.

- The most prominent international museum organization
- Attempted from 1980 to 1995 to create one standard E-R schema for all museums and then gave up.
- Arrived at about 400 tables, 2000 attributes without success. Many museum needs were not yet covered.
- Decided in 1996 to replace it by an object-oriented “Conceptual Reference Model” (CRM) – nowadays an “ontology”...



Correlated Ontologies

History of the CIDOC CRM – the Problem

Cultural information is more than a domain:

- Collection description (art, archeology, natural history....)
- Archives and literature (records, treaties, letters, artful works..)
- Administration, preservation, conservation of heritage material
- Science and scholarship – investigation, interpretation
- Presentation – exhibition, teaching, publication

But how to make a documentation standard?

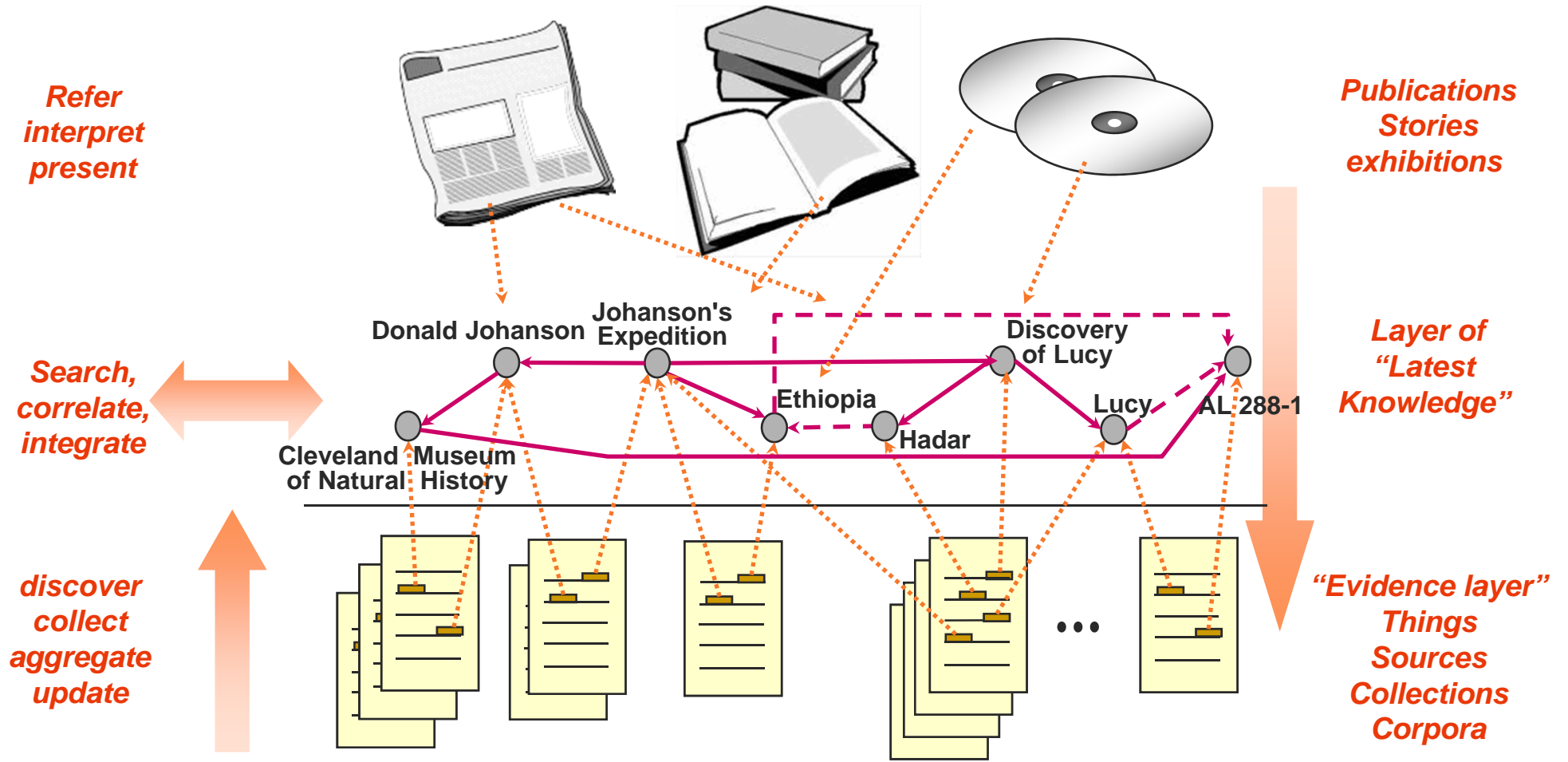
- Each aspect needs its methods, forms, communication means
- Data overlap, but do **not fit in one** schema
- Understanding lies in the relationships; but how to express them?

The key idea: separate data(entry) management from information integration for (re)search.



Correlated Ontologies

Research Processes in Arts and Science





Correlated Ontologies

Functionality of an Integration Model

- It must be crafted by deep **knowledge engineering**, generalizing in a **bottom-up** manner **from actually used**, specific data structures used as **empirical base** to find the generic structures
 - **common questions** across multiple domains
- It should contain **only** classes needed to describe **relationships**. It should be independent from the meaning of **local terminology** (e.g., “wineglass”) not contributing to data structure.
- It should support **Local as View integration**. It must fit **rich and poor** models under **one common logical framework** (rich property hierarchies)
- It should be **small enough** to limit the complexity of **querying** and **comprehension**. This can be achieved by appropriate **generalizations** of classes **and** properties .
- Information integration can be achieved by an “**extensible core ontology of relationships**” that provides **shared explanation** rather than prescription of a **common data structure** (avoiding local optimization needs!).



Correlated Ontologies

Challenge: Integrating Poor and Rich...

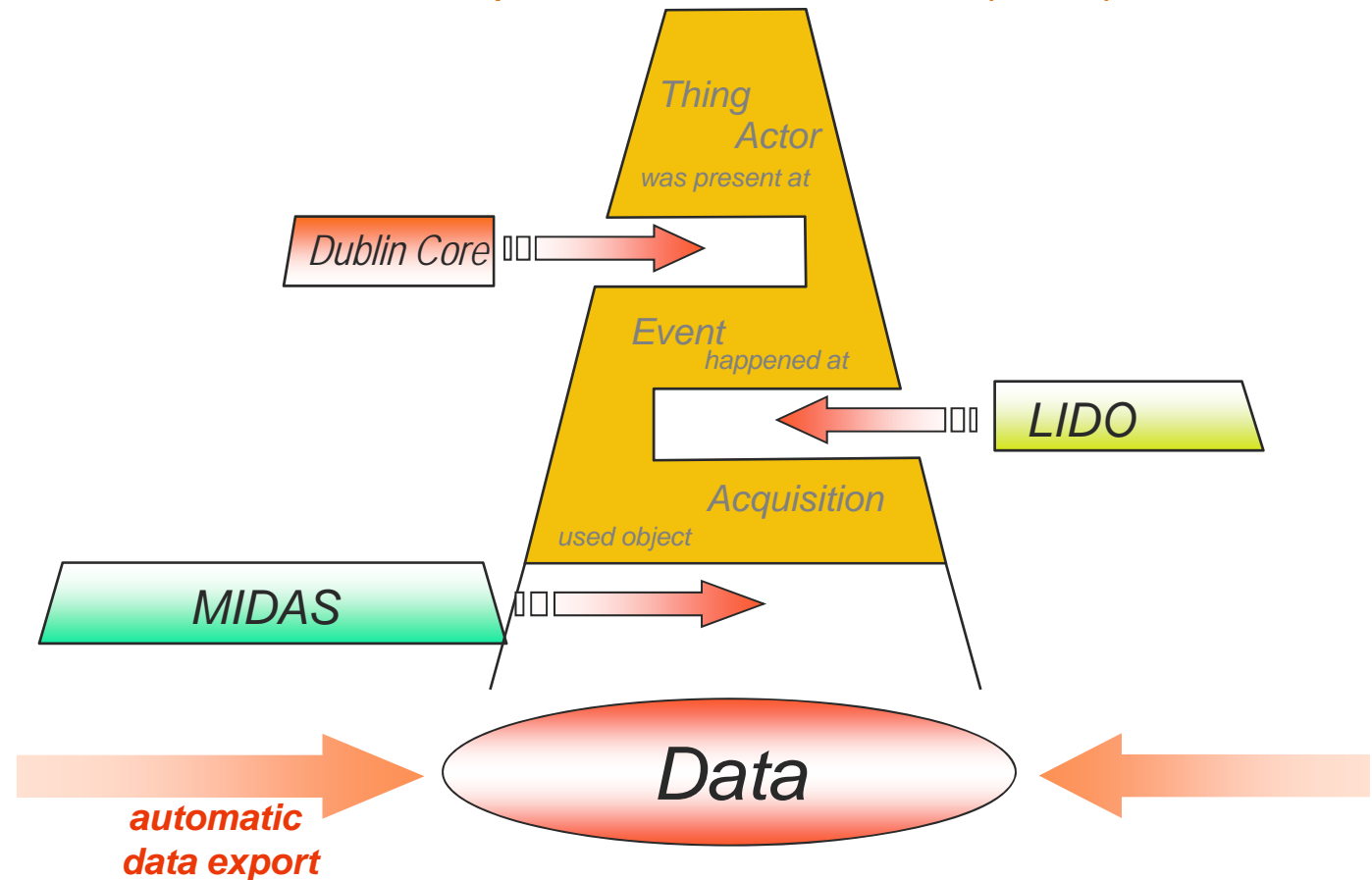
Access *all* data from *any* level:

*Few concepts,
high recall*

subsumption

*Special concepts,
high precision*

CIDOC
Conceptual Reference Model (CRM)





Correlated Ontologies

Historical Archives...

Type: Text
Title: Protocol of Proceedings of Crimea Conference
Title.Subtitle: II. Declaration of Liberated Europe
Date: February 11, 1945
Creator: The Premier of the Union of Soviet Socialist Republics
The Prime Minister of the United Kingdom
The President of the United States of America
Publisher: State Department
Subject: Postwar division of Europe and Japan

Metadata

Documents

About...

“The following declaration has been approved:
The Premier of the Union of Soviet Socialist Republics,
the Prime Minister of the United Kingdom and the President
of the United States of America have consulted with each
other in the common interests of the people of their countries
and those of liberated Europe. They jointly declare their mutual
agreement to concert...
....and to ensure that Germany will never again be able to
disturb the peace of the world..... “



Correlated Ontologies

Images, non-verbose...

Type: Image
Title: Allied Leaders at Yalta
Date: 1945
Publisher: United Press International (UPI)
Source: The Bettmann Archive
Copyright: Corbis
References: Churchill, Roosevelt, Stalin

Metadata



About...

Photos, Persons





Correlated Ontologies

Places and Objects

TGN Id: 7012124

Names: Yalta (C,V), Jalta (C,V)

Types: inhabited place(C), city (C)

Position: Lat: 44 30 N, Long: 034 10 E

Hierarchy: Europe (continent) ← Ukrayina (nation) ← Krym (autonomous republic)

Note: ...Site of conference between Allied powers in WW II in 1945;

Source: TGN, Thesaurus of Geographic Names

Places, Objects

About...



Title: Yalta, Crimean Peninsula

Publisher: Kurgan-Lisnet

Source: Liaison Agency

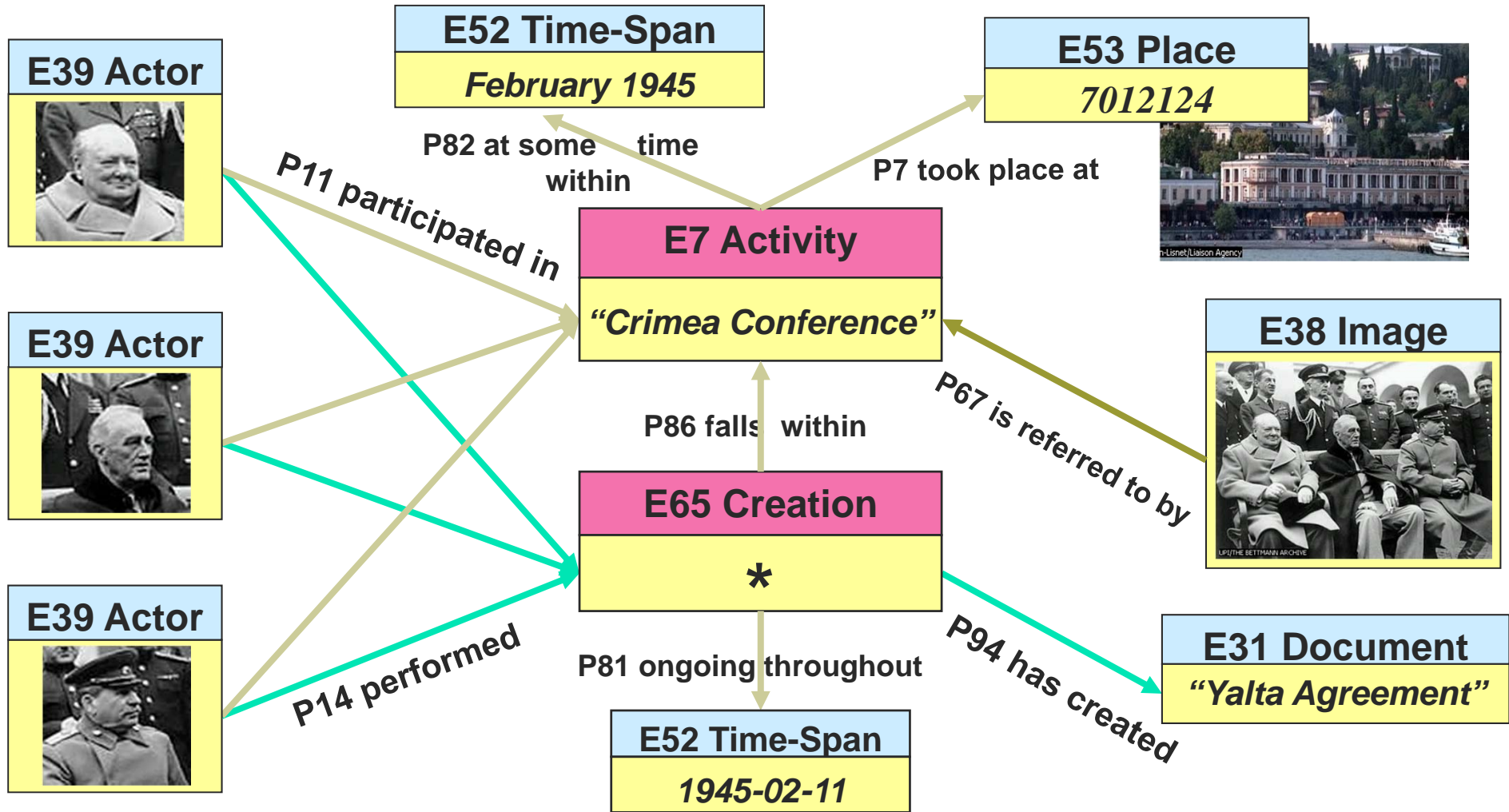


Kurgan-Lisnet/Liaison Agency



Correlated Ontologies

Detect the Relevant Entities: the Activity





Correlated Ontologies

Outcomes

The CIDOC Conceptual Reference Model

- A **collaboration** with the International Council of Museums
- An ontology of 86 classes and 137 properties for **culture** and **more**
- With the capacity to **explain** hundreds of (meta)data formats
- Accepted by ISO TC46 in September 2000
- International standard since 2006 - ISO 21127:2006

Serving as:

- **intellectual guide** to create schemata, formats, profiles
- A language for analysis of existing sources for integration/mediation
“Identify elements with **common meaning**”
- **Transportation format** for data integration / migration / publication
- A **language** that S/W developers and museum experts can **share**.



Correlated Ontologies

CIDOC CRM Development Team

The CIDOC CRM SIG:

- *A Working Group/ Consortium of **stakeholders** and their representatives under the **ae**gis of CIDOC, **reporting** to CIDOC.*
- *Meeting 3-4 times per year, e-mail communications and decisions.*
- *Contacts with projects, application experience, **feedback**.*
- ***Each** individual **step**, rationale, decision **is documented** and published. All **versions** preserved. A highly disciplined, formal process.*
- ***Authoritative** acceptance of decisions by **CIDOC** General Assembly, usually on complete releases.*
- *Acting as “community representatives” for ISO*
- *Delivering “community drafts” to ISO*



Correlated Ontologies

CIDOC CRM Managerial Process

- Definition of a **theoretical scope**: “Museum information relevant for **publishing**”; “The things **curators** document **in data structures**” etc.
- Definition of an **empirical source** (“practical scope”) - initially the CIDOC Relational Model – that is continuously **extended** as work goes on.
- **Source elements** (table, class, attribute) are interpreted as classes or properties for defining **meaning shared** with equivalent sources or supporting relevant research questions.
 - *Reduction principle: Classes are introduced only as **anchors** of properties (i.e. if structurally relevant). New properties are only introduced if **relevant for querying** integrated resources*
- A **work programme** going from one element to the next, one functional unit to the next, one source schema to the next, increasing, revising the ontology, complemented by **submission of “issues”** raised by users.
- A series of “**products**”, published forms, is maintained.



Correlated Ontologies

The Bottom-Up Engineering Process

- 1. Take a list of intuitive, specific terms, typically found in domain documents (“practical scope”).**
 - too abstract concepts are often badly designed or missed!
- 2. Create a list of properties for these terms**
 - **essential** properties to infer **identity** (coming into being, ending to be)
 - relevant properties (**behavior**) for the discourse
 - split term into concepts if necessary (“**Where** was the **university** when it **decided** to take more students?”)
- 3. Detect new classes from property ranges.**
 - Typically strings, names, numbers hide concepts.
 - Identify concepts independent from the relation: “Who can be a “creator”?”



Correlated Ontologies

The Bottom-Up Engineering Process

- 4. Detect entities hidden in attributes, find their properties**
 - From literal types to entity classes
- 5. Property consistency test**
 - Test domain queries
 - Revise properties and classes
- 6. Create the class hierarchy**
 - Revise properties and classes
- 7. Create property hierarchies**
 - Revise properties and classes
- 8. Close up the model - reduce the model**
 - Find gaps, asymmetries in detail, coverage, modeling patterns.
 - Delete properties and classes not needed to implement the required functions.



Correlated Ontologies

Technical Methods

Defining the Model:

- First get a **graphical representation** of the **source** (in functional units), **textual definition** of the source, **data examples** of the source.
- Discuss interpretations. Draft a **graphical target model** for the **part** under investigation (~3-4 classes, ~ 5 properties, white board). Discuss meaning. Sketch **definitions**.
- Relate/**integrate** manually (graphically) with pre-existing **target model**. (typically 2 days of work, .ppt). Possibly **modify existing** parts to resolve misfits, over-specializations.
- Write scope notes and didactic examples.
- **Verify formally** by TELOS (on SIS-TMS).
- Check non-formal logical consistency (scope notes, declared intentions etc.). Describe **source-target mapping** formally.
- **Release** textual definitions and **changes** to previous versions.
- **Update** derived products.
- Eventually inform ISO (1. revision due 2013).



Correlated Ontologies

Products

- TELOS Mastercopy (without scope notes)
- **Authoritative** text:
 - *Introduction with examples* (need adaptations to class/property name changes)
 - *Class definitions*: Superclass, subclass, scope note, example, properties
 - *Property definitions*: Superclass, subclass, scope note, example, properties
- **Translations** of authoritative text (French, German, Greek, Chinese, Japanese, ...)
- **Cross-Reference Manual**: Authoritative text in English, classes with inherited properties.
- **Graphical representation** covering the model in **functional views** (*34 functional units*).
- RDFS: with different flavours of identifiers.
- OWL?

Maintenance version by version: 26 versions so far.

Every change must be propagated through all products.



Correlated Ontologies

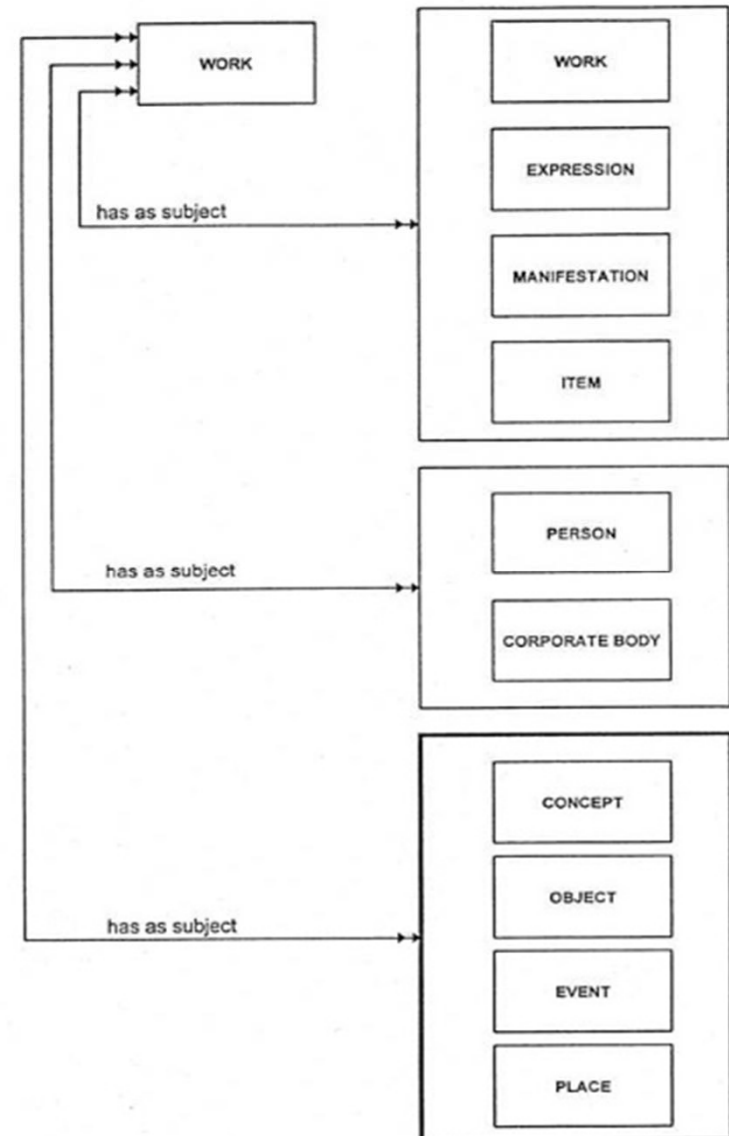
FRBR_{ER} : Functional Requirements for Bibliographic Records

Figure 3.3: Group 3 Entities and “Subject” Relationships

Analysis starts with a source view.

Here: A library model

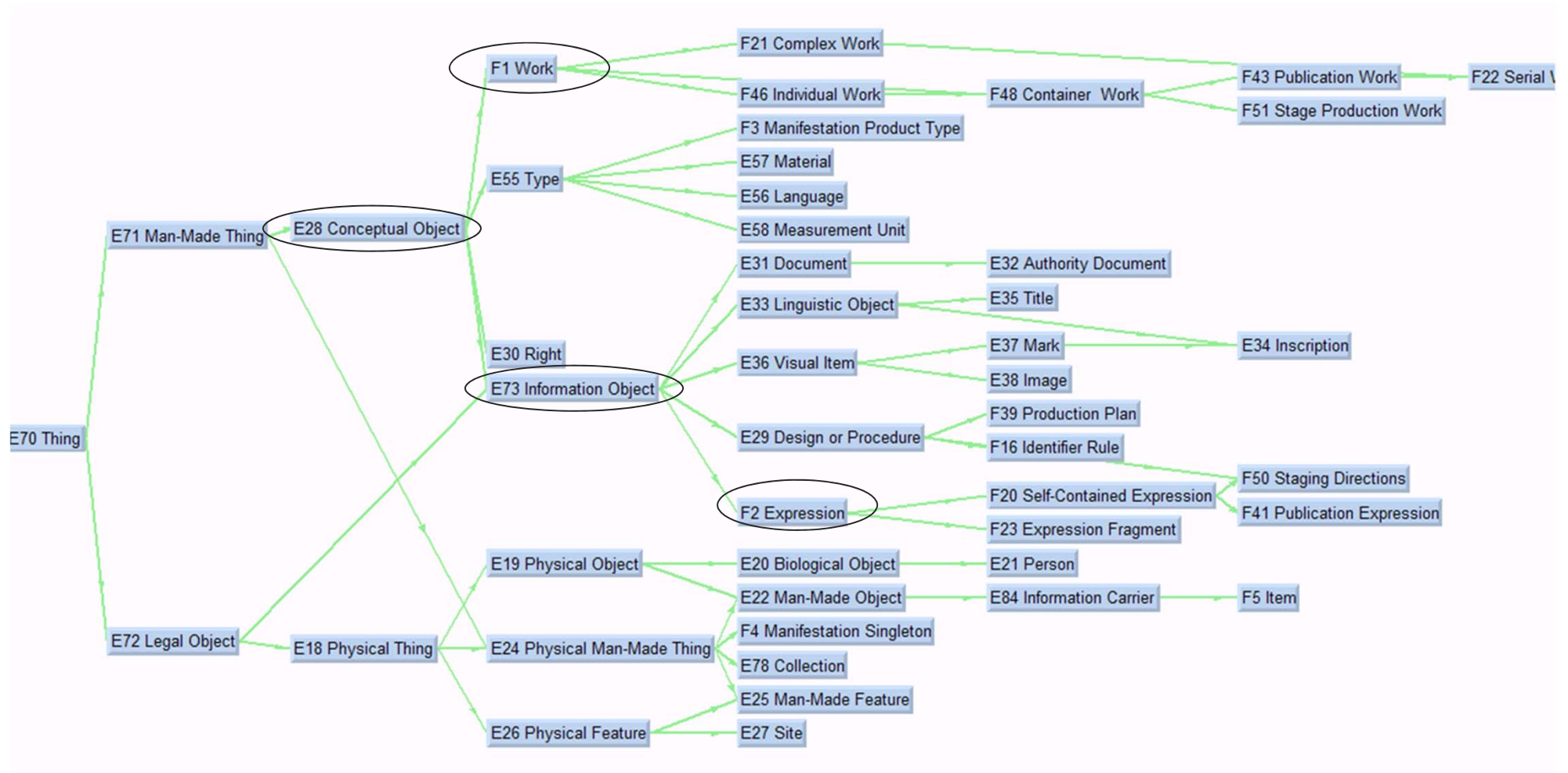
Source Views





Correlated Ontologies

Existing classes of CIDOC CRM





Correlated Ontologies

http://www.cidoc-crm.org/issues.php?id=158

The CIDOC CRM

Functional Requirements for Bi...

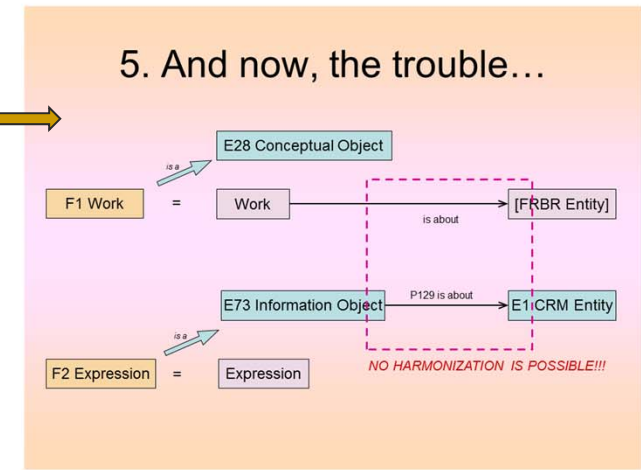
The CIDOC Conceptual Reference Model

Home | The CIDOC CRM | Activities | People | Resources | FRBR-CRM | External References

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Issue 158

Title	Intermediate class between E28 Conceptual Object and E73 Information Object
Background	<p>A) Patrick gave a presentation with title Subject relationships in FRBROO and their implication on CIDOC CRM to address the issues</p> <ol style="list-style-type: none"> Intermediate class between Conceptual Object and Information Object Appellation as a subclass of String <p>After the presentation we discuss about the substance of Appellation and if the appellation has alternative form and history. Also we changed in the SIS base the Appellation and we put Appellation isA Information Object in order to check the consequences.</p> <p>In parallel we examined the Issue 144 according to which <i>E7 Activity. P16 used specific object (was used for):E70 Thing</i> should be superproperty of <i>F33 Identifier Assignment.R26: F13 Name</i>, and this implies: that E41 Appellation isA E70 Thing!! In order to solve this ambiguity we should consider E41 Appellation isA Information Object.</p> <p>B) Then the SIG addresses the issue of <i>subject relationships</i>. Should we have an intermediate class in CIDOC CRM between E28 Conceptual Object and E73 Information Object, so that we could solve the current conflict between the modelling of subject relationships in FRBRER and in CIDOC CRM, which results in an impossibility to model them in FRBRoo?</p>

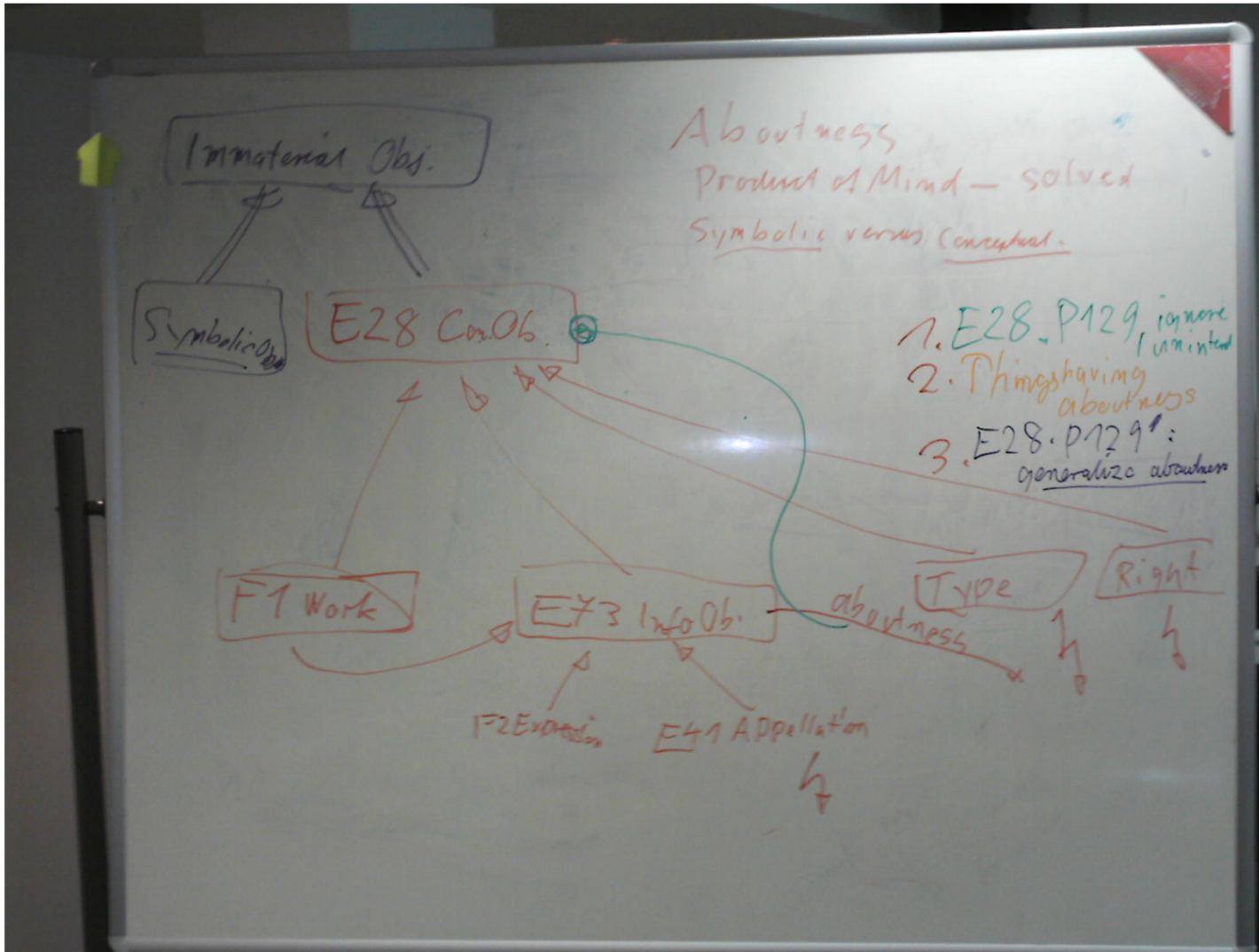




Correlated Ontologies

10th FRBR / 15th CIDOC CRM SIG Harmonization Meeting
e-Science Institute, Edinburgh (United Kingdom), 9-12 July 2007

Discussion Drafts

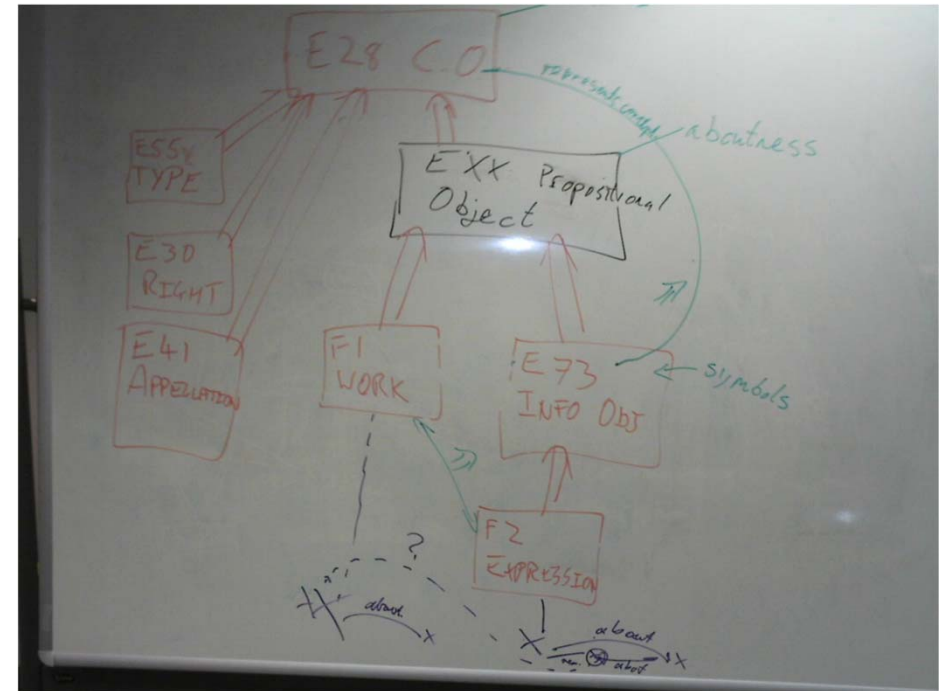
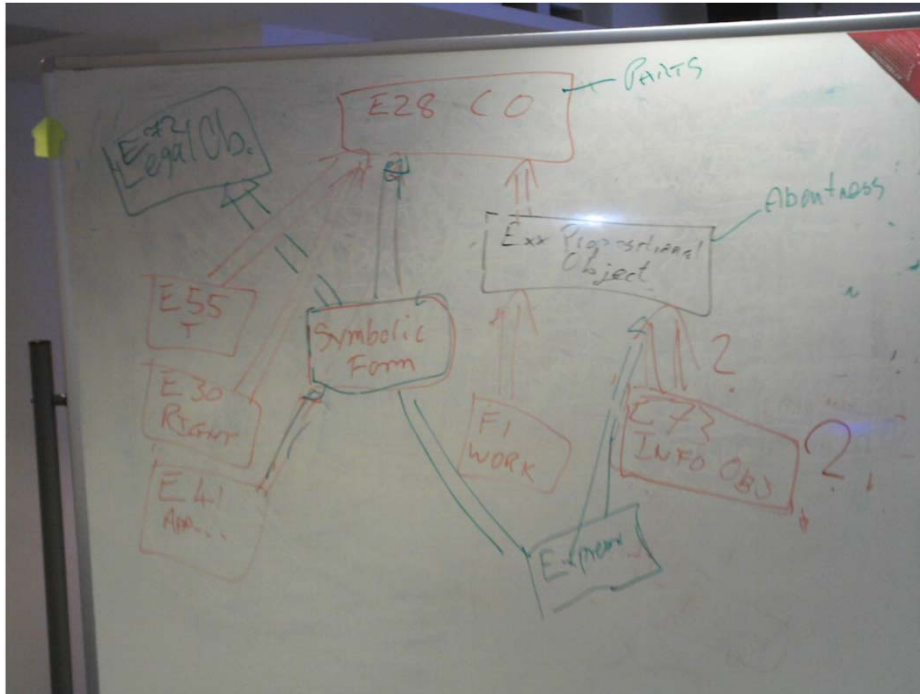




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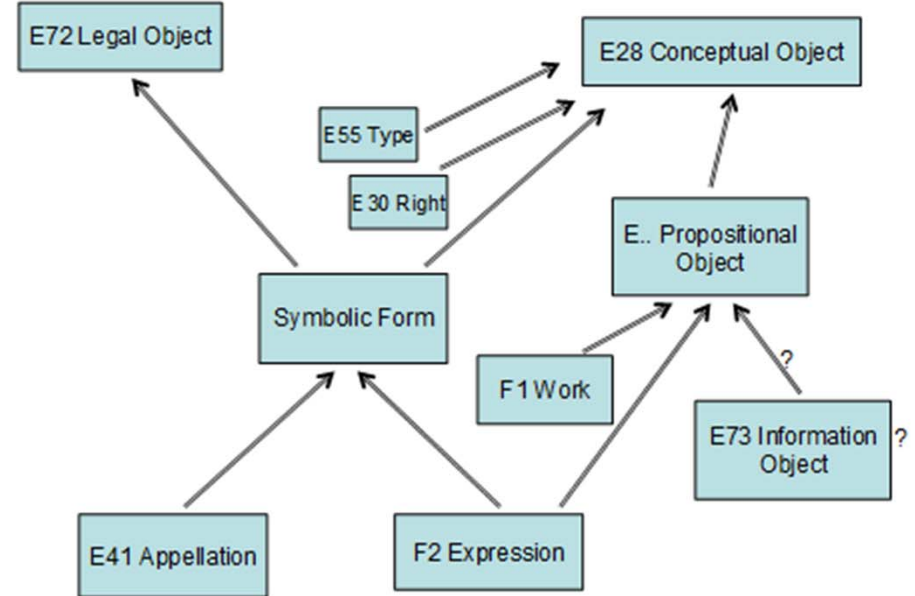
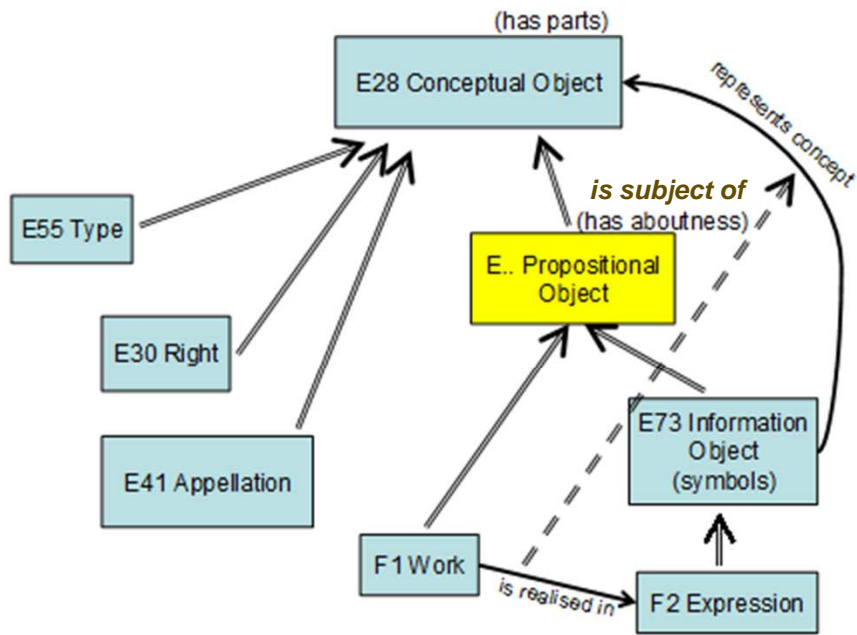




Correlated Ontologies

Draft Target Model in Minutes

10th FRBR / 15th CIDOC CRM SIG Harmonization Meeting
e-Science Institute, Edinburgh (United Kingdom), 9-12 July 2007





Correlated Ontologies

12th FRBR / 17th CIDOC CRM SIG Harmonization Meeting
ICS-FORTH, Heraklion, Crete, 12-15 May 2008

scope note and properties

E89 Propositional Object

Subclass of: E28 Conceptual Object
Superclass of: E73 Information Object
E30 Right

Scope note: This class comprises immaterial items, including but not limited to prescriptions, algorithms, laws of physics or images that represent propositions about real or mental things and that are a topic of discourse.

This class also comprises items that are “about” something in a wider sense, this class includes expressions of psychological or musical themes. However, conceptual items such as terms are not Propositional Object. This should not be confused with an instance of E89 Propositional Object.

Examples:

- Maxwell’s Equations
- The ideational contents of Aristotle’s book entitled ‘Metaphysics’ translated in ... Oxford edition...
- The underlying prototype of any “no-smoking” sign (E30)
- The common ideas of the plots of the movie “The Seven Years War” and the movie “The Magnificent Seven” by John Sturges.
- The image content of the photo of the Allied Leaders at Yalta

Properties:

P148 has component (is component of) E89 Propositional Object
P67 refers to (is referred to by): E1 CRM Entity
(P67.1 has type: E55 Type)
P129 is about (is subject of): E1 CRM Entity

P67 refers to (is referred to by)

Domain: E89 Propositional Object

P129 is about (is subject of)

Domain: E89 Propositional Object
Range: E1 CRM Entity
Subproperty: E89 Propositional Object. P67 refers to (is referred to by): E1 CRM Entity
Quantification: many to many (0..n;0..n)

Scope note: This property documents that an E89 Propositional Object has as subject an instance of E1 CRM Entity.

This differs from P67 refers to (is referred to by), which refers to an E1 CRM Entity, in that it describes the primary subject or subjects of an E89 Propositional Object.

Examples:

- The text entitled ‘Reach for the sky’ (E33) is about Douglas Bader (E21)

E90 Symbolic Object

Subclass of: E28 Conceptual Object
E72 Legal Object
Superclass of: E73 Information Object
E41 Appellation

Scope note:

This class comprises identifiable symbols and any aggregation of symbols, such as characters, identifiers, traffic signs, emblems, texts, data sets, images, musical scores, multimedia objects, computer program code or mathematical formulae that have an objectively recognizable structure and that are documented as single units.

It includes sets of signs of any nature, which may serve to designate something, or to communicate some propositional content.

An instance of E90 Symbolic Object does not depend on a specific physical carrier, which can include human memory, and it can exist on one or more carriers simultaneously. An instance of E90 Symbolic Object may or may not have a specific meaning, for example an arbitrary character string.

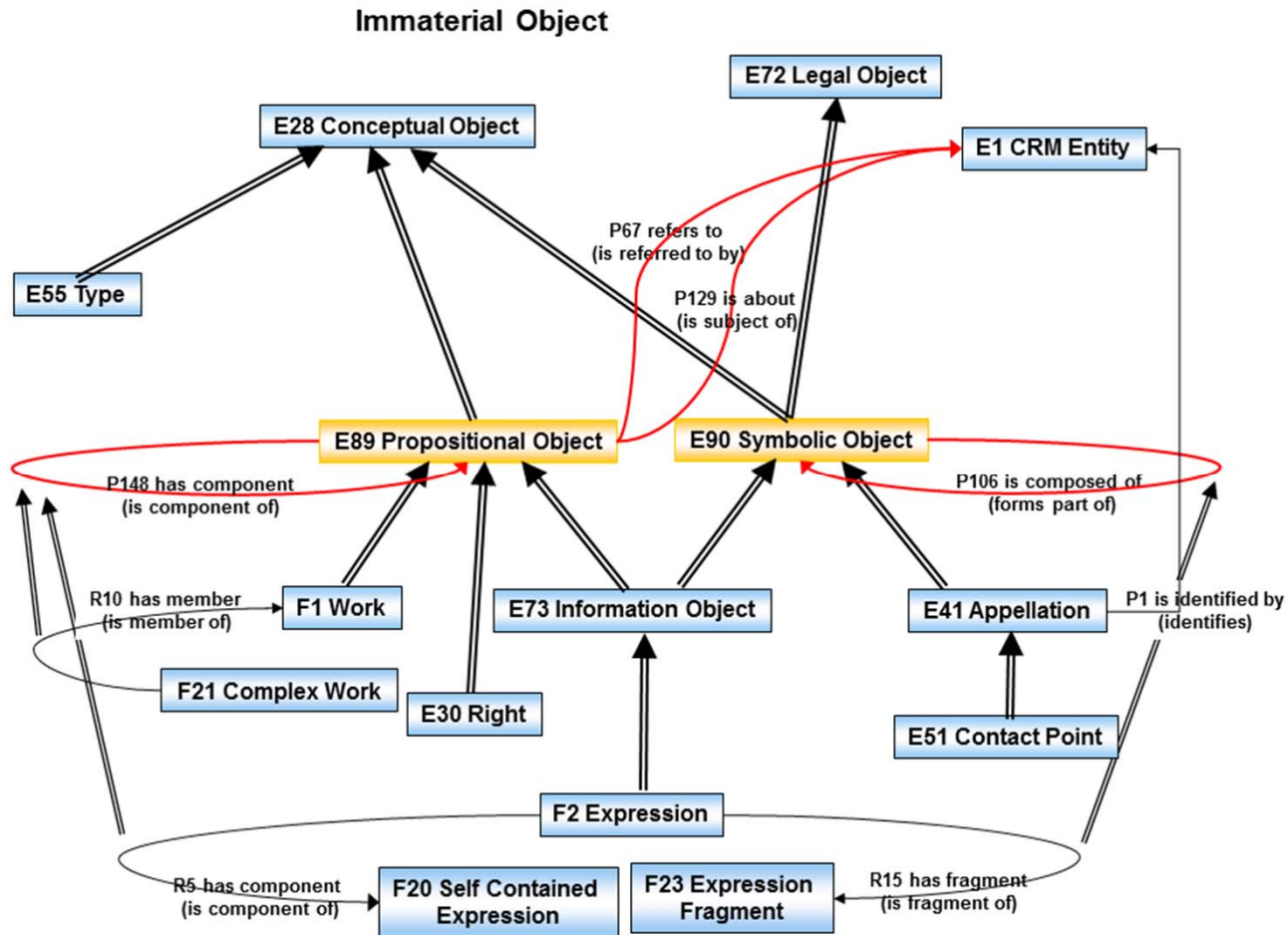
Examples:

- ‘recognizabl’
- The “no-smoking” sign (E36)
- ‘BM000038850.JPG’ (E75)
- image BM000038850.JPG from the Clayton Herbarium in London (E38)



Correlated Ontologies

Integrated Target View





Correlated Ontologies

Products: *The TELOS Mastercopy*

*running on SIS,
a product of FORTH*

The screenshot displays the SIS CIDOC (5.0.4) application window. The main area shows a classification tree for 'E28 Conceptual Object'. The tree structure is as follows:

- E28 Conceptual Object
 - F6 Concept
 - E55 Type
 - F3 Manifestation Product Type
 - E56 Language
 - E57 Material
 - E58 Measurement Unit
 - E89 Propositional Object
 - F1 Work
 - F21 Recording Work
 - F15 Complex Work
 - F14 Individual Work
 - F16 Container Work
 - E30 Right
 - F17 Aggregation Work
 - F20 Performance Work
 - F19 Publication Work
 - F18 Serial Work
 - E73 Information Object
 - E31 Document
 - E32 Authority Document
 - F26 Recording
 - F2 Expression
 - F22 Self-Contained Expression
 - F24 Publication Expression
 - F23 Expression Fragment
 - F25 Performance Plan
 - E29 Design or Procedure
 - E33 Linguistic Object
 - E35 Title
 - E37 Mark
 - E36 Visual
 - E90 Symbolic Object
 - E82 Actor
 - E75 Concept
 - E49 Time
 - E42 Identifier
 - F12 Name
 - E44 Place
 - E51 Container
 - E41 Appellation
 - E43 Identifier Rule

Two property windows are open:

- E89 Propositional Object**
 - Media
 - SIMPLE
 - Belongs to: Concept Type, CIDOC_Entity
 - Subclass of: E28 Conceptual Object
 - Superclass of: F1 Work, E73 Information Object, E30 Right
 - Properties: short cut, legal status (P105 right held by (has right on): E39 Actor (short cut of : E30 Right))
 - identifications (P1 is identified by (identifies): E41 Appellation, P149 is identified by (identifies): E75 Concept)
- E90 Symbolic Object**
 - Media
 - SIMPLE
 - Belongs to: Concept Type, CIDOC_Entity
 - Subclass of: E72 Legal Object, E28 Conceptual Object
 - Superclass of: E73 Information Object, E41 Appellation
 - Properties: short cut, legal status (P130 shows features of (features are also found on): (P130.1 kind of similarity : E55 Type)), intellectual contents (P130.1 kind of similarity : E55 Type), short cut (P48 has preferred identifier (is preferred identifier of):)



Correlated Ontologies

Products: CIDOC Definition

“Definition of the CIDOC Conceptual Reference Model”

- The *authoritative* document of CIDOC/ICOM
- Target of change requests (“issues”)
- “Community Draft” for *ISO21127*
- Maintained manually from TELOS mastercopy

E5 Event

Subclass of: [E4 Period](#)
Superclass of: [E7 Activity](#)
[E63 Beginning of Existence](#)
[E64 End of Existence](#)

Scope note: This class comprises changes of states in cultural, social or physical systems, regardless of scale, brought about by a series or group of coherent physical, cultural, technological or legal phenomena. Such changes of state will affect instances of [E77 Persistent Item](#) or its subclasses.

The distinction between an E5 Event and an E4 Period is partly a question of the scale of observation. Viewed at a coarse level of detail, an E5 Event is an ‘instantaneous’ change of state. At a fine level, the E5 Event can be analysed into its component phenomena within a space and time frame, and as such can be seen as an E4 Period. The reverse is not necessarily the case: not all instances of E4 Period give rise to a noteworthy change of state.

Examples:

- the birth of Cleopatra ([E67](#))
- the destruction of Herculaneum by volcanic eruption in 79 AD ([E6](#))
- World War II ([E7](#))
- the Battle of Stalingrad ([E7](#))
- the Yalta Conference ([E7](#))
- my birthday celebration 28-6-1995 ([E7](#))
- the falling of a tile from my roof last Sunday
- the CIDOC Conference 2003 ([E7](#))

Properties:

[P11](#) had participant (participated in): [E39 Actor](#)
[P12](#) occurred in the presence of (was present at): [E77 Persistent Item](#)

E6 Destruction

Subclass of: [E64 End of Existence](#)

Scope note: This class comprises events that destroy one or more instances of [E18 Physical Thing](#) such that they lose their identity as the subjects of documentation.

Some destruction events are intentional, while others are independent of human activity. Intentional destruction may be documented by classifying the event as both an E6 Destruction and E7 Activity.

Products: Cross-Reference Manual

E14 Condition Assessment

Subclass of: E13 Attribute Assignment

Scope Note: This class describes the act of assessing the state of preservation of an object during a particular period.

The condition assessment may be carried out by inspection, measurement or through historical research. This class is used to document circumstances of the respective assessment that may be relevant to interpret its quality at a later stage, or to continue research on related documents.

Examples:

* last year's inspection of humidity damage to the frescos in the St. George chapel in our village

Properties

P1 is identified by (identifies): E41 Appellation

P17 was motivated by (motivated): E1 CRM Entity

P19 was intended use of (was made for): E71 Man-Made Thing

(P19.1 mode of use: E55 Type)

P20 had specific purpose (was purpose of): E5 Event

P21 had general purpose (was purpose of): E55 Type

P137 exemplifies (is exemplified by): E55 Type

(P137.1 in the taxonomic role: E55 Type)

P2 has type (is type of): E55 Type

P11 had participant (participated in): E39 Actor

P14 carried out by (performed): E39 Actor

(P14.1 in the role of: E55 Type)

P16 used specific object (was used for): E70 Thing

(P16.1 mode of use: E55 Type)

P33 used specific technique (was used by): E29 Design or Procedure

(P16.1 mode of use: E55 Type)

P34 concerned (was assessed by): E18 Physical Thing

P12 occurred in the presence of (was present at): E77 Persistent Item

(P19.1 mode of use: E55 Type)

P34 concerned (was assessed by): E18 Physical Thing

P12 occurred in the presence of (was present at): E77 Persistent Item

P15 was influenced by (influenced): E1 CRM Entity

P140 assigned attribute to (was attributed by): E1 CRM Entity

P8 took place on or within (witnessed): E19 Physical Object

(short cut of: E46 Section Definition)

P7 took place at (witnessed): E53 Place

P4 has time-span (is time-span of): E52 Time-Span

P134 continued (was continued by): E7 Activity

P120 occurs before (occurs after): E2 Temporal Entity

P119 meets in time with (is met in time by): E2 Temporal Entity

P118 overlaps in time with (is overlapped in time by): E2 Temporal Entity

P117 occurs during (includes): E2 Temporal Entity

P116 starts (is started by): E2 Temporal Entity

P115 finishes (is finished by): E2 Temporal Entity

P114 is equal in time to: E2 Temporal Entity

P10 falls within (contains): E4 Period

P9 consists of (forms part of): E4 Period

P132 overlaps with: E4 Period

P133 is separated from: E4 Period

P35 has identified (was identified by): E3 Condition State

P141 assigned (was assigned by): E1 CRM Entity

P3 has note: E62 String

(P3.1 has type: E55 Type)

P32 used general technique (was technique of): E55 Type

P125 used object of type (was type of object used in): E55 Type

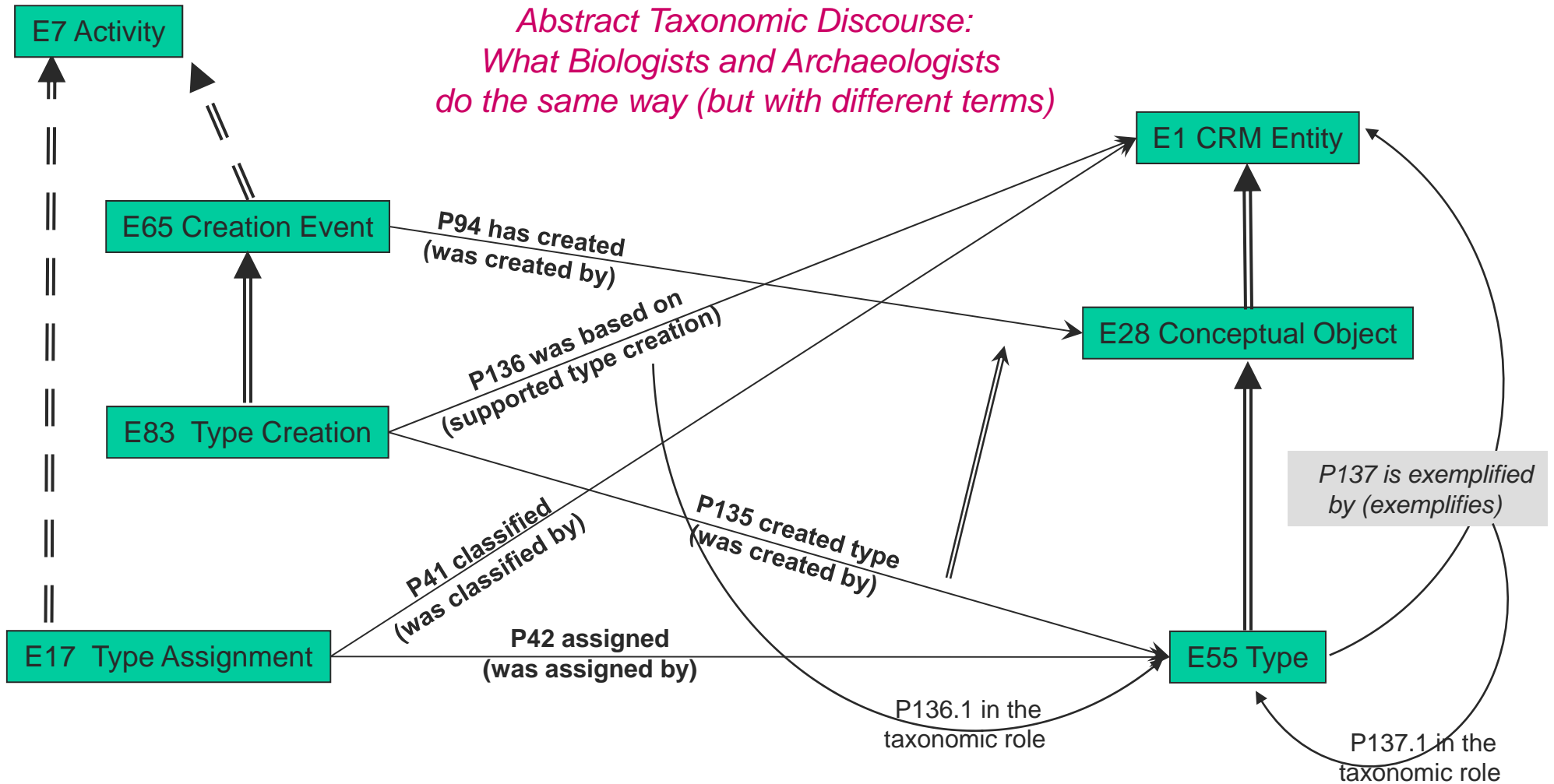
It is not supported by current tools !!





Correlated Ontologies

Products: Functional Views





INTERNATIONAL COUNCIL OF MUSEUMS

The CIDOC Conceptual Reference Model

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Official Release

What's New?

Issue 165

Title	Scope note of E81
Background	Cardinality of transformation is not properly formulated.
Old Proposal	<input type="checkbox"/>
Current Proposal	<input type="checkbox"/>
Outcome	<p>The SIG was changed the scope note of E81 Transformation to a better formulation of cardinality. So the scope note and the example of E81 Transformation were changed from:</p> <p>Scope note: This class comprises the events that result in the simultaneous destruction of one E77 Persistent Item and the creation of another E77 Persistent Item that preserves recognizable substance from the first but has a fundamentally different nature and identity.</p> <p>Although the two instances of E77 Persistent Item are treated as discrete entities having separate, unique identities, they are causally connected through the E81 Transformation; the destruction of the first E77 Persistent Item directly causes the creation of the second using or preserving some relevant substance. Instances of E81 Transformation are therefore distinct from re-classifications (documented using E17 Type Assignment) or modifications (documented using E11 Modification) of objects that do not fundamentally change their nature or identity. Characteristic cases are reconstructions and repurposing of historical buildings or ruins, fires leaving buildings in ruins, taxidermy of specimen in natural history and the reorganization of a corporate body into a new one.</p> <p>Examples: the death and mummification of Tut Ankh Amun (transformation of Tut Ankh Amun from a living person to a mummy)</p> <p>To:</p> <p>Scope note: This class comprises the events that result in the simultaneous destruction of</p>



▪ E81 Transformation – issue 165 ¶

¶ The scope note and the example of E81 Transformation were changed from: ¶

This class comprises the events that result in the simultaneous destruction of one E77 Persistent Item and the creation of another E77 Persistent Item that preserves recognizable substance from the first but has a fundamentally different nature and identity. ¶

¶ Although the two instances of E77 Persistent Item are treated as discrete entities having separate, unique identities, they are causally connected through the E81 Transformation; the destruction of the first E77 Persistent Item directly causes the creation of the second using or preserving some relevant substance. Instances of E81 Transformation are therefore distinct from re-classifications (documented using E17 Type Assignment) or modifications (documented using E11 Modification) of objects that do not fundamentally change their nature or identity. Characteristic cases are reconstructions and repurposing of historical buildings or ruins, fires leaving buildings in ruins, taxidermy of specimen in natural history and the reorganization of a corporate body into a new one. ¶

Examples: → ¶

- → the death and mummification of Tut Ankh Amun (transformation of Tut Ankh Amun from a living person to a mummy) ¶

¶ To: ¶

This class comprises the events that result in the simultaneous destruction of one or more than one E77 Persistent Item and the creation of one or more than one E77 Persistent Item that preserves recognizable substance from the first one(s) but has fundamentally different nature and identity. ¶

¶ Although the old and the new instances of E77 Persistent Item are treated as discrete entities having separate, unique identities, they are causally connected through the E81 Transformation; the destruction of the old E77 Persistent Item(s) directly causes the creation of the new one(s) using or preserving some relevant substance. Instances of E81 Transformation are therefore distinct from re-classifications (documented using E17 Type Assignment) or modifications (documented using E11 Modification) of objects that do not fundamentally change their nature or identity. Characteristic cases are reconstructions and repurposing of historical buildings or ruins, fires leaving buildings in ruins, taxidermy of specimen in natural history and the reorganization of a corporate body into a new one. ¶

Examples: → ¶

- → the death and mummification of Tut Ankh Amun (transformation of Tut Ankh Amun from a living person to a mummy) (E69, E81, E7) ¶



Correlated Ontologies

Extensions

CRM-SIG extensions

- FRBRoo

Extensions in collaboration with FORTH

- *Europeana EDM (generalization)*
- *CRMDig (Digital Provenance)*
- *SOM (Scientific Observation Model)*
- *KPLab Model (Knowledge Creation Practices)*
- *Digital Rights Model*
- *Clinical Studies Model (Cancer Research)*
- *Factual Argumentation Model (Archaeology etc.)*

Other Groups

- *Philosophical argumentation*
- *Many cultural domain models: (e.g. Malayan Textiles)*



Correlated Ontologies

Extensions

All extensions together form *one coherent* model:

- human activities, their context and products (“provenance”, “metadata”),
- particular things under human consideration,
- methods of knowing (epistemology).
- but NOT: categorical laws of nature, classification systems, causation etc.

Particularly successful and effective in terms of application, semantic consistency and *reasoning capability*.

Method applied:

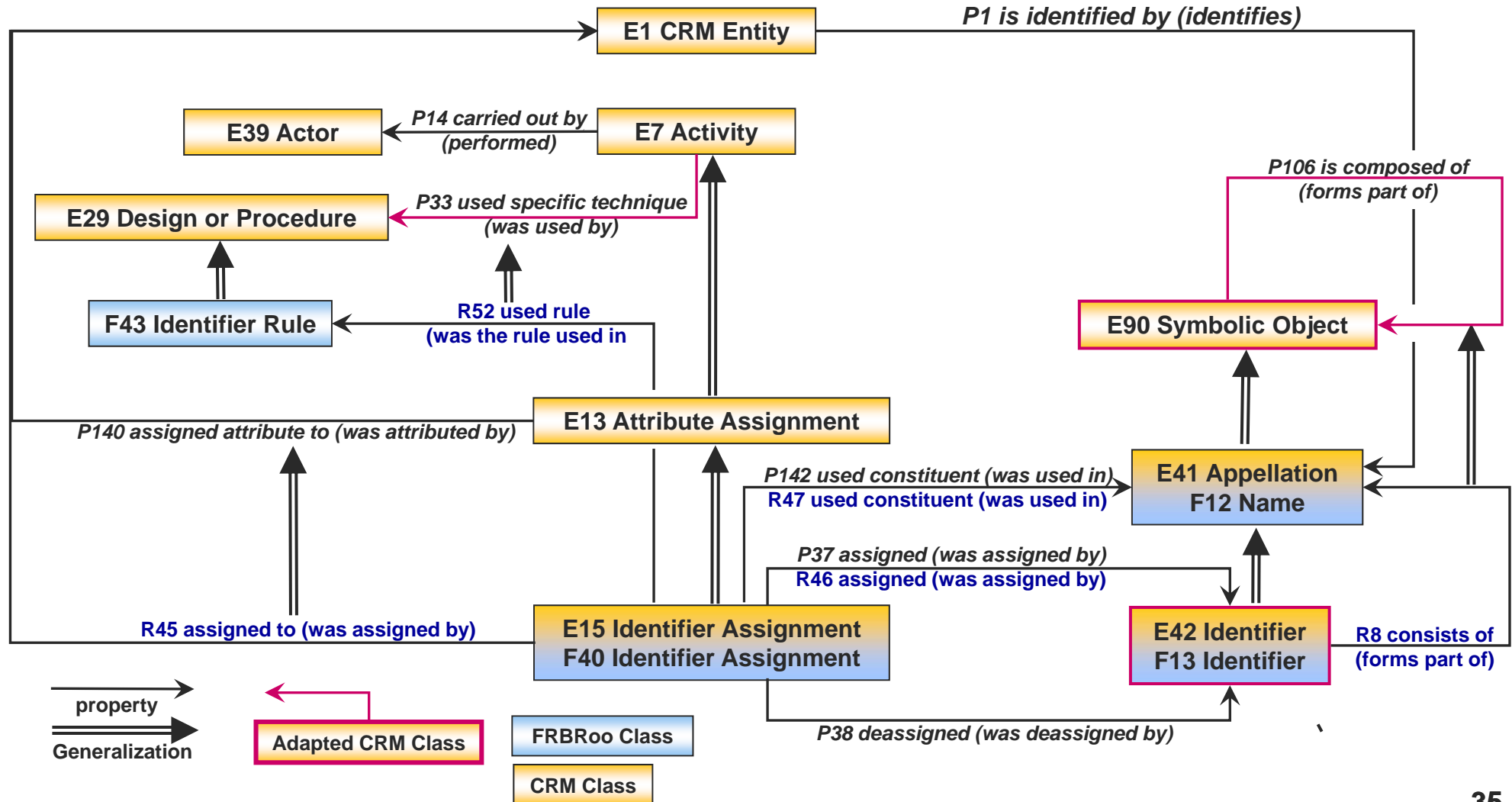
- Undergeneralization** (maintains monotony/backwards compatibility under later generalization)
- Harmonization**: Revision of all concepts of all modules under new evidence, “articulation (intermediate concepts)”, generalization of properties
- Stable Separation** between modules primarily by *functional* specifications, secondarily by domain of discourse

=> Very complex update process of the related products!



Correlated Ontologies

Harmonization: Adapting CRM to FRBR extension





Correlated Ontologies

Conclusions

*We have shown that large (schemas)ontologies **covering multiple domains** can be built in a modular way*

- *consistently without compromising semantic rigor,*
- *from generic to specific, reusing all others concepts*

Only flexible graphical representations allow for control of “ontological commitment”,

- *i.e., that experts can decide if the model fits their conceptualizations*

Tools desperately needed to show the effect of inheritance and functional units.

- *Protégé tools are inadequate for large systems.*

Highly modular ontologies (such as Inspire) suffer from severe inconsistencies between abstraction layers due to lack of suitable views.



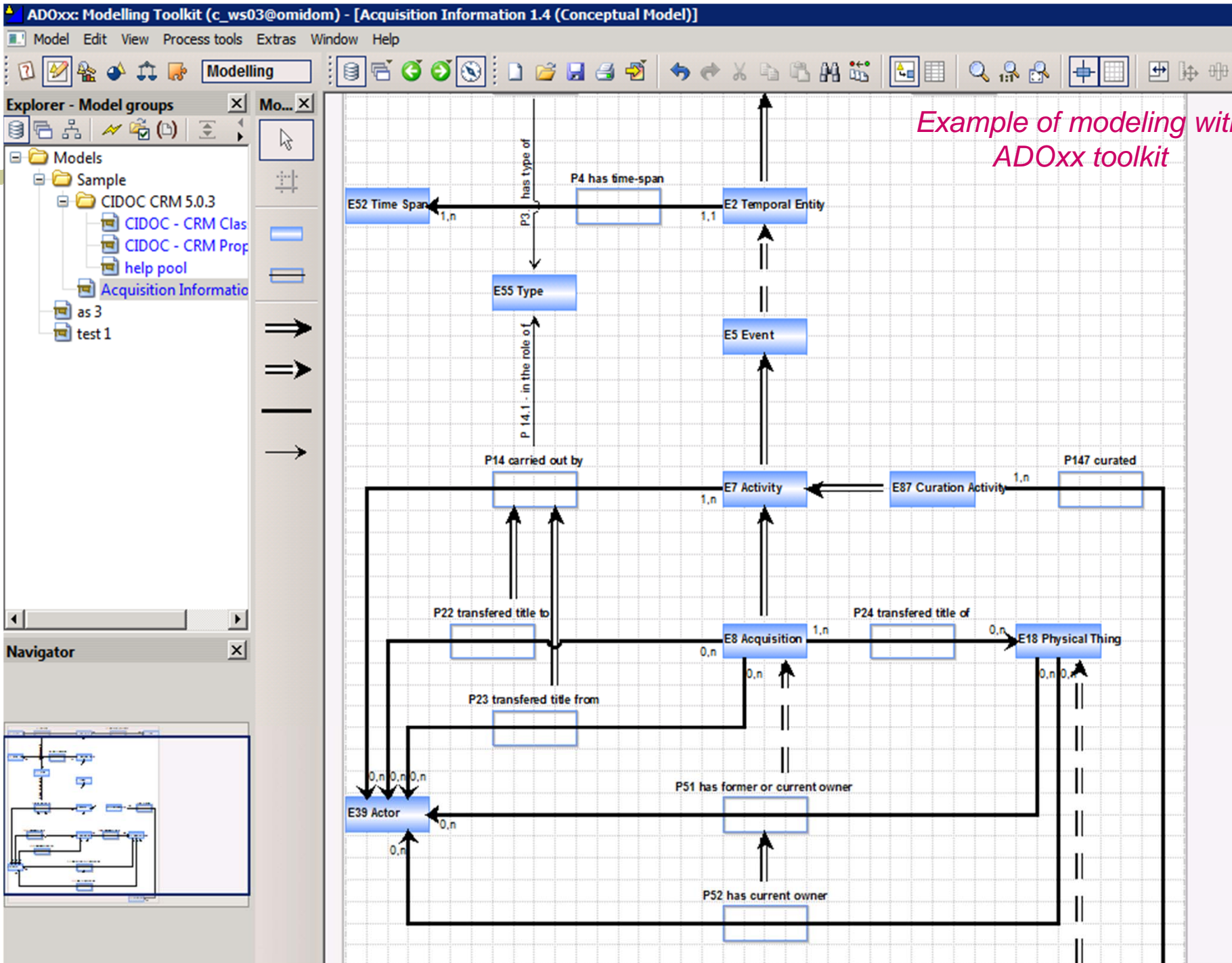
Correlated Ontologies

Conclusions

Major requirements for tools:

- *Import and visualization of source views,*
 - *quick selection of concepts to be shown*
 - *challenge: find criteria for view generation.*
- *Intuitive layout principles of draft views (IsA upwards, properties horizontal, 3D style)*
- *Integration of views into a master copy*
- *Integration of master copy with correlated ontologies (super/sub- modules)*
- *Export of master copy*
- *Updates of referred concepts from correlated ontologies*
- *Automated maintenance of products:*
 - *mastercopy*
 - *texts,*
 - *translations (similar to industrial manuals maintenance)*
 - *RDFS and other encodings*

No adequate tools on the market!





Correlated Ontologies

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Thank you!

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