46th joint meeting of the CIDOC CRM SIG and ISO/TC46/SC4/WG9; 39th FRBR - CIDOC CRM Harmonization meeting.

25-28 February 2020

Hellenic National Committee of ICOM

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Tuesday 25th February 2020

ISSUE 474: Editorial check of changes in CRMarcheo

The sig went through the editorial changes proposed by CEO, AF and GH. A summary of the changes accepted and relevant discussion points can be found below. Changes in the scope notes/examples/quantification of properties etc. are thoroughly listed under Appendix 2.

A1 Excavation Process Unit:

DECISION: The sig accepted CEO's edit to add the reference to the class in the example and fix the reference to AP10 destroyed. The details can be found in the Appendix.

PROPOSAL: SS proposed that the label of this class be changed to A1 Excavation Processing Unit to better capture that the class is a specialization of E7 Activity. The sig members present were in favor of this change.

DECISION: The change of the label is to be put up for an email vote.

A7 Embedding:

DECISION: to be dealt with in the designated issue (447), not part of the editorial work.

A8 Stratigraphic Volume:

DECISION: FOL representations for inferences regarding its superclasses (E26 Physical Feature and E53 Place) need be added.**HW** to CEO.

A9 Archaeological Excavation

Editorial change accepted about the fact that the range of property *AP3 investigated (was investigated by).* The details can be found in the Appendix.

A10 Excavation Interface

Editorial change accepted about the deletion of *AP4 produced surface (was surface produced by)* from the associated properties listed under *A10 Excavation Interface*

AP2 discarded into (was discarded by)

The sig reviewed the changes proposed by CEO and did some editorial work on the scope note. The edited scope notes (can be found in the [Appendix](.))

DECISION: The sig accepted CEO's proposal to change the label of AP2 from "discarded into" to "discarded" –given that the property makes no claim regarding the direction towards which the removed amount of material was discarded (which is also consistent with the definition of its superproperty).

DECISION: Upon reviewing the quantification of AP2, the sig decided to move this discussion in a [new issue](). The quantification of the property must explore the following possibilities:

(i)   many instances of S11 Amount of Matter are removed and discarded into one heap (in which case it must be differentiated form O2 removed and from O5 removed (this one for sample taking).

(ii)   the exact amount of matter that was removed in the course of an excavation process unit. However, if the amounts of matter are subsequently discarded in a heap, and this move is documented for some reason, then another property will have to be coined, that lumps the amounts of matter together.

(iii)   the amount of matter discarded instantiates the heap, which means that AP2 should be used to document the excavation process units that fed into the heap.

AP4 produced surface (was surface produced by)

DECISION: The sig accepted CEO's proposal to **change the range of AP4 from S20 Rigid Physical Feature to A10 Excavation Interface**. CEO proposed the AP4 to be subproperty of   P108 has produced (was produced by): E24 Physical Human-Made Thing. In this case we should make A10 Excavation Interface a subclass of E24 Physical Human-Made Thing and A1 Excavation Process Unit a subclass of E12 Production. There was no decision on this proposal since it is pending the discussion in the issue 446.

AP5 removed part or all of (was totally or partially removed by)

DECISION: the sig will start a new issue regarding the superproperty of **AP5**. Candidates involve P31 has modified (D: E11 Modification; R: E18 Physical Thing). Any decision will affect the definition of A1 Excavation Process[ing] Unit (see issue 446) and should inform issue 446.

The new issue should be of a more general interest than the particulars of AP5's superproperty, and address the question of declaring superproperties in the CRMbase exclusively (to the extent it's possible) or across family models.

HW: CEO (?) to check the CRMbase properties that generalize to CRM extensions. (this is the content of new issue)

AP6 intended to approximate (was approximated by)

The sig reviewed the example of AP6 and made the following changes:

From:

The stratigraphic Excavation Process Unit excavating the Stratigraphic Volume Unit   (2) intended to approximate Stratigraphic Interface [19].

To:

The excavation in ancient Akrotiri (A1) *intended to approximate* the various interfaces witnessing the sequences of eruption of ancient Santorini's volcano (A3) (see Fig. 8).

AP9 took matter from (provided matter to).

DECISION: The sig appointed AF and MD to provide the missing scope note for AP9 and rewrite the example to express the forward property instead of its inverse. SS will proofread **(HW)**.

AP10 destroyed (was destroyed by)

DECISION

To resolve this issue, the sig proposed to make A1 a subclass of E81 Transformation. The argumentation is that every time you have an A1Excavation Process Unit activity something is destroyed in its identity and something is created with a new identity. Also by this proposal it is captured the start and end existence properties.

AP11 has physical relation (is physical relation of)

DECISION: The scope note needs be redrafted to include a clause that any two A8 Stratigraphic Units linked through the property should share an interface. There was a question about generalization in terms of geology and a suggestion to look for a property in CRMsci that would cover also geological relations of this type.

In what concerns the example: it must be added the AP11.1 property (the type of adjacency observed btw two instances of A8).

HW assigned to **MD** to redraft the scope note. **SS** will edit. Also **M**D appointed himself with providing relevant examples.

AP12 confines (is confined by)

An example is missing. No HW assignment.

AP13 has stratigraphic relation (is stratigraphic relation of)

DECISION: in what concerns the example, it must be made explicit that *earlier* is an inferred relation instantiating an AP13.1 property. The example needs editing.

NO HW assignment.

AP14 justified (is justification of)

DECISION: the sig will revise the Domain and Range for AP14 in a new issue. AP14 could either connect instances of physical adjacency and stratigraphic relations or it should be replaced by some construct in CRMinf.

The sig **decided** to make a new issue for re discussion about the Domain and Range of AP14, since connecting the type to the type does not seem correct. It should point to the instance of the relations (the reified property) or the whole thing could be replaced by some CRMinf construct. SS suggests to put square brackets around the first and second relations and how they relate.

MD should make a proposal.

AP15 is or contains remains of (is or has remains contained in)

The following example proposed by CEO and AF is accepted:

The posthole, Dilling 2AS34019, (A2) *is or contains remains of (is or has remains contained in)* the rotten bottom part of a pole (S10).

AP16 assigned attribute to (was attributed by)

The following example proposed by CEO and AF is accepted:

The excavator declaration that the post holes [7] and [8] to be part of one building (A6) assigned attribute to the post holes [7] and [8] (E18) (see fig. 4)

Properties AP17 is found by, AP18 is embedding of, AP19 is embedding in and AP20 is embedding at

were not discussed because they are to be considered in the context of [Issue 447: A7 Embedding as a Physical Feature like entity](#).

AP22 is equal in time to

DECISION: The sig ratified the result of the e-vote to deprecate **P114 is equal in time to** from CRMbase and introduce it as **AP22 is equal in time to** in CRMarchaeo. The proposal to delete the reference to E52 Time-Span from the scope note and other editorial changes were approved. The details can be found in the [Appendix](#).

AP23 finishes (is finished by)

DECISION: The sig ratified the result of the e-vote to deprecate **P115 finishes (is finished by)** from CRMbase and introduce it as **AP23 finishes (is finished by)** in CRMarchaeo.

The definition can be found in the [Appendix](#).

AP24 starts (is started by)

The sig ratified the result of the e-vote to deprecate **P116 starts (is started by)** from CRMbase and introduce it as **AP24 starts (is started by)** in CRMarchaeo. The proposal to delete the reference to E52 Time-Span from the scope note and other editorial changes were approved. The details can be found in the [Appendix](#).

AP25 occurs during (includes)

DECISION: The sig ratified the result of the e-vote to deprecate **P117 occurs during (includes)** from CRMbase and introduce it as **AP25 occurs during (includes)** in CRMarchaeo. Editorial changes suggested were approved. The details can be found in the [Appendix](#).

HW: SS was appointed to reformulate the scope note and remove the references to E52 Time-Span from the definition.

AP26 overlaps in time with (is overlapped in time by)

DECISION: The sig ratified the result of the e-vote to deprecate **P118 overlaps in time with (is overlapped in time by)** from CRMbase and introduce it as **AP26 overlaps in time with (is overlapped in time by)** in CRMarchaeo. Editorial changes suggested were approved. The details can be found in the [Appendix](#).

HW: SS was appointed to reformulate the scope note and remove the references to E52 Time-Span from the definition. The sig should invite for email vote the result for phrasing.

AP27 meets in time with (is met in time by)

DECISION: The sig ratified the result of the e-vote to deprecate **P119 meets in time with (is met in time by)** from CRMbase and introduce it as **AP27 meets in time with (is met in time by)** in CRMarchaeo. Editorial changes suggested were approved. The details can be found in the [Appendix](#)

DECISION: The sig ratified the result of the e-vote to deprecate **P120 occurs before (occurs after)** from CRMbase and introduce it as **AP28 occurs before (occurs after)** in CRMarchaeo. The details can be found in the [Appendix](#)

NEW ISSUE: Quantification of AP2 discarded (was discarded by).

Upon reviewing the quantification of AP2 (issue 474), the sig decided to move this discussion in a new issue. The quantification of the property must explore the following possibilities:

(i)   many instances of S11 Amount of Matter are removed and discarded into one heap (in which case it must be differentiated form O2 removed and from O5 removed (this one for sample taking).

(ii)   the exact amount of matter that was removed in the course of an excavation process unit. However, if the amounts of matter are subsequently discarded in a heap, and this move is documented for some reason, then another property will have to be coined, that lumps the amounts of matter together.

(iii)   the amount of matter discarded instantiates the heap, which means that AP2 should be used to document the excavation process units that fed into the heap.

NEW ISSUE: superproperties of family models in CRMbase and/or across extensions.

DECISION: the sig will start a new issue regarding the superproperty of **AP5**. Candidates involve P31 has modified (D: E11 Modification; R: E18 Physical Thing). Any decision will affect the definition of A1 Excavation Process[ing] Unit (instead of E12 Production or S1 Matter Removal; see issue 446) and should inform issue 446.

The new issue should be of a more general interest than the particulars of AP5's superproperty, and address the question of declaring superproperties in the CRMbase exclusively (to the extent it's possible) or across family models.

HW: CEO (?) to check the CRMbase properties that generalize to CRM extensions. Family model classes/properties should be used when there is no appropriate class/property in CRMbase.

NEW ISSUE: AP14 justified (us justification of)

The sig decided to start a new issue regarding how to link the inference that two stratigraphic volumes in a given topological relation of physical adjacency justify a stratigraphic (i.e. temporal) relation between the events that produced them.

Proposed alternatives for AP14: it either connects instances of physical adjacency and stratigraphic relations or it should be replaced by some construct in CRMinf.

CRMtex; A CIDOC CRM extension for modelling Ancient Textual Entities

presentation by Francesca Murano (FM) & Achille Felicetti (AF)

DECISION: the definition of CRMtex will be reviewed by CEO, MD, GB, PR and CM.

Matching CIDOC CRM with Architectural Conservation

presentation by Donatella Fiorani (DF) & Marta Acierno (MA)

Linked Art

presentation by Rob Sanderson (RS) & George Bruseker (GB).

The presentation addressed some open issues that have been put up for discussion in the sig.

ISSUE 476: Pxx represents entity of type

DECISION: The sig discussed the necessity of introducing such a property and agreed to it. Sig members did not oppose to the introduction of a property used when the specific entity being represented is either unknown, or not of documentary interest. The scope note proposed by RS is to be put up for discussion over the next sig meeting.

ISSUE 475: Transfer of custody

DECISION: Since the scope note for E10 Transfer of Custody is not all too well understood, it probably it needs revising. [**HW** unassigned, RS to propose new scope note that resolves ambiguities present]

Swiss Art Research Infrastructure; development and semantics
presentation by Nicola Carboni (NC)

Sharing Knowledge of our pasts: a practical look at the state of the art and future potentials of semantic data, the CIDOC CRM and museums
keynote speech by George Bruseker (GB).

Wednesday, 26 February 2020

ISSUE 419: Activity Plans

The sig reviewed the HW by TV –scope notes and examples for properties connecting from/to socE4 Event Template.

NOTE: socE4 Event Template was previously known as socE4 Trigger Event Template. It got renamed to include event templates for active AND reactive plans.

DECISION: a clause must be added to the scope note of socE4 Event Template indicating that event specifications triggering the execution of activity plans may refer to past events or anticipate future ones.

HW: TV to look "system workflow specifications" on the different levels of event templates, i.e. one event template being a specialization of another.

The scope notes and examples for the following properties have been accepted with minor modifications:

socPxx foresees (is foreseen by)

Domain: socE2 Activity Plan
Range: socE4 Event Template
Quantification:

Scope note: This property associates an instance of socE2 Activity Plan with an instance of socE4 Event Template, which specifies constraints for the activity intended or foreseen by that instance of socE2 Activity Plan.

Examples:

- The disaster plan of the Tate Archives (socE2) *foresees* the event template (socE4), which specifies the water-tight doors of the archive store rooms to be shut.
- My wedding plan (socE2) *foresees* the event template (socE4), which specifies the date (12th August), place (Cardiff Castle) and the minister (Rev. Glyn Tidwell) taking the service.

In First Order Logic:

socP17 has trigger (is trigger for)

Domain: socE2 Activity Plan
Range: socE4 Event Template
Quantification:

Scope note: This property associates an instance of socE2 Activity Plan with an instance of socE4 Event Template, which specifies the qualities of the event that will trigger the activity plan. This property can be used to describe the kind of event that should cause a reactive activity plan to be executed.

Examples:

- The disaster plan of the Tate Archives (socE2) *has trigger* the event template (socE4), which specifies the event of the river Thames flooding reaching Millbank.

In First Order Logic:

socP24 specifies material substantial (is specified material substantial)

Domain: socE4 Event Template
Range: S10 Material Substantial
Quantification: 0,n:0,n

Scope note: This property associates an instance of socE4 Event Template with an instance of S10 Material Substantial, which the template specifies be used or be present during the specified event.

Examples:

- The event template (socE4), which triggers the disaster plan of the Tate Archives *specifies material substantial* the fluid body of the river Thames (S14).

In First Order Logic:

$$socP24(x,y) \supset socE4(x)$$
$$socP24(x,y) \supset S10(y)$$

socP23 specifies actor (is specified actor of)

Domain: socE4 Event Template
Range: E39 Actor
Quantification: 0,n:0,n

Scope note: This property associates an instance of socE4 Event Template with the instance of E39 Actor specified by the template as taking part in the specified event.

Examples:

- The template specifying my wedding (socE4) specifies actor the Rev. Glyn Tidwell (E21) be present to undertake the wedding service.
- The event template (socE4) for the treatment proposal for MS Greek 418 specifies actor the conservator Nicholas Pickwoad (E21) be present to undertake the repair.

In First Order Logic:

$$socP23(x,y) \supset socE4(x)$$
$$socP23(x,y) \supset E39(y)$$

socP18 specifies event type (is specified event type of)

Domain: socE4 Event Template
Range: E55 Type
Quantification: 0,n:0,n

Scope note: This property associates an instance of socE4 Event Template with the E55 Type of the E5 Event, which the template specifies.

Examples:

- The disaster plan of the Tate Archives is triggered by the river Thames flooding (socE4), which specifies event type: "flood" (E55).

In First Order Logic:

$$socP18(x,y) \supset socE4(x)$$
$$socP18(x,y) \supset E55(y)$$

socP20 specifies type of thing (is specified type of thing of)

Domain: socE4 Event Template
Range: E55 Type
Quantification: 0,n:0,n

Scope note: This property associates an instance of socE4 Event Template with the type (E55 Type) of a thing, which the template specifies be used or be present for the specified event. On the other hand, a particular instance of a thing that is required should be specified using the property socP24 specifies material substantial (is specified material substantial).

Examples:

- My wedding plan requires an event template (socE4), which specifies the type of thing: "wedding ring" (E55) [but does not specify which instance of a wedding ring it is].

In First Order Logic:

socP20(x,y) ⊃ socE4(x)
socP20(x,y) ⊃ E55(y)

socP19 specifies the role type of a required actor (is the role type of a required actor)
DECISION: A reference to the fact that the property corresponds to P14.1 must be included in the scope note.

sopP19 specifies the role of a required actor (is the role of a required actor)

Domain: socE4 Event Template
Range: E55 Type
Quantification: 0,n:0,n

Scope note: This property associates an instance of socE4 Event Template with the E55 Type of the role required by the template for the participation of some instance of E39 Actor. The property does not require a specific instance of E39 Actor to be specified by socP23 specifies actor (is specified actor of).

Examples:

- The template specifying my wedding (socE4) specifies the role of a required actor as disc jokey (E55) [so that someone plays music for the wedding guests].

In First Order Logic:

socP19(x,y) ⊃ socE4(x)
socP19(x,y) ⊃ E55(y)

socP22 specifies time-span (is specified time-span of)
DECSION: The sig decided to change this property into a *falls within* kind, which would then connect to the timespan specified by means of P170 defines time (time is defined by).

HW: The sig appointed MD to rewrite the scope note and example for the new socP22. This is to be done separately, in a new issue, which would also involve rewriting the scope note and examples for socP21.

socP21 specifies place (is specified place of)
DECSION: In a similar vein, the sig decided to make socP21 specifies place a *falls within* kind of property (buuut for places).

HW: The sig appointed MD to rewrite the scope note and example for this new socP21. This is to be done separately, in a new issue, which would also involve rewriting the scope note and examples for socP22.

DECISION: The sig reviewed the scope note and example proposed by TV. More thought has to be put in terms of what an event interpreted as the trigger for the execution of an activity plan amounts to. Instances of said E5 Events must include those that were believed to match the template at the time they were unfolding, despite ultimately been proven to not match it after all. The model must be able to distinguish among instances of E5 Event that matched vs. seemingly matched the template.

HW: TV to rethink this property (with the help of the LCD community).
HW: TV, GB, MA (Marta Acierno) to find suitable examples from the domain of risk assessment in conservation, especially data from disaster prevention networks and anything that relates to the conservation/restauration of architectural monuments in case of earthquakes or other disasters.

DECISION: Upon discussing this property, the sig resolved to start a [new issue](#) concerning the possibility that the CRM can contribute to the semantic representation in risk assessment (in conservation). The idea is to take into account the state-of-the-art in the domain and methods of risk assessment in conservation and see whether the CIDOC CRM can interface the domain.
HW: CM, MA, DF, ML. Linked Conservation Data consortium is to be contacted directly (TV) and especially Amina.

socPxx matched template (is template for)
Domain: E5 Event
Range: socE4 Event Template
Quantification:

Scope note: This property associates an instance of E5 Event with an instance of socE4 Event Template, which it matches. The event matches the specified template when all of the instances recorded by the event template properties are observed during the event.

Examples:

- My wedding (E7) *matched template* (socE4), which was produced by my wedding planner and specifed to take place on the 12th August, at Cardiff Castle with the Rev. Glyn Tidwell taking the service.

In First Order Logic:

socPxx specifies situation
DECISION: The sig appointed TV to discuss with the LCD consortium, how the condition constraints for activity plans are used or could be used for searching in conservation

This is homework for me to discuss in LCD how the condition constraints for activity plans are used or could be used for searching in conservation. So we are parking this property until we understand better where integration is needed.

NEW ISSUE: scope notes for socP21 and socP22:
While discussing property socP21 specifies place and socP22 specifies time, it was suggested and agreed by the sig members present that these properties should best be rendered as *falls within* properties for place and time, respectively.

HW: The sig appointed MD to rewrite the scope notes and examples to reflect new properties.

NEW ISSUE: CIDOC CRM interfacing risk assessment in conservation.

While discussing property socPxx matched template (is template for) of CRMsoc [issue 419], the sig resolved to start a new issue concerning the possibility that the crm can contribute to the semantic representation in risk assessment (in conservation). The idea is to take into account the state-of-the-art in the domain and methods of risk assessment in conservation and see whether the CIDOC CRM can interface the domain.

HW: CM, MA, DF, ML. Linked Conservation Data consortium is to be contacted directly (TV) and especially Amina.

Linked Conservation Data; *Recording absence*
Presentation by Thanasis Velios (TV)

DECISION: The options presented by TV are to be tested for best performance.

HW: PF & ML are to test them with one or two negative properties over some toy case. The solution that fares better will be recommended over the others. CM is to provide the queries. TV will put in writing the statement for the recommendations.

Analysis of Scientific Questions in Archaeology
Presentation by Martin Doerr (MD). https://isl.ics.forth.gr/archaeological_questions/

ISSUE 349: Belief Values
DECISION: The sig resolved to reopen the issue, as proposed by TV. It was mistakenly closed, it had drifted to the approximation of dimensions, but was originally about uncertainty of statements. As the sig still hasn't provided guidelines on how to express uncertainty of statements, the issue will remain open.

ISSUE 360: LRMoo
PR organized LRMoo issues in broader thematic groupings and presented each topic to the sig. In what follows, the reader can navigate through the issues discussed in the context of each broader topic.

TOPIC_1: Aggregation/containers
DECISION: In the context of this broader topic the sig ratified the decision made in Paris (June 2019) to deprecate F16 Container Work in favor of expressing meronymic relations through properties.

DECISION: all relevant classes deprecated, the sig resolved that a specific reference to aggregations/containers will be part of the **Model Overview** section of the LRMoo definition.

DECISION: It was agreed among sig members that **Rxx uses expression [D: F1 Work, R: F1 Work]** is a misnomer and creates confusion; the ambiguity won't be solved by changing the range to F2 Expression (original suggestion), **BUT** by changing the label of the property to: **Rxx uses expression from (has expression used in) [D:F1; R:F1]**, instead.
HW: PR to provide the scope note for new property.

NO DECISION regarding the domain of Rnn incorporates external expression (is external expression incorporated in) [D: F2 Expression, R: E2 Expression] was reached.

DECISION: the sig reviewed the proposed definitions for new property **Rxx has elaboration (is elaboration of)** and revised property **R67 has part (forms part of)** –each corresponding to a distinct reading for R10 has member (is member of). The details can be found below:

Rxx has elaboration (is elaboration of) [new LRMoo property]

Domain:	F1 Work
Range:	F1 Work
Subproperty of:	F1 Work. R10 has member (is member of): F1 Work
Quantification:	(0,n:0,n)
Scope note:	This property associates an instance of F1 Work with another instance of F1 Work that constitutes an elaboration of the work. Sibling works that are elaborations of the same parent represents specializations, for example, in the form of versions or alternatives. This property is transitive.
	Expressions that realize an F1 Work will also realize the F1 Work that it is an elaboration of.
Examples:	Tolkien's work entitled "The Hobbit" (F1) *has elaboration* Tolkien's textual work intended for children, entitled "The Hobbit" (F1) and first published in 1937.
	Tolkien's work entitled "The Hobbit" (F1) *has elaboration* Tolkien's textual work entitled "The Hobbit" (F1) that was published as the second edition of "The Hobbit" in 1951. [The latter is a major revision with sections adapted to match the textual work "The Lord of the rings".]
	Beethoven's opera work identified as Op 72 (F1) *has elaboration* Beethoven's opera work "Leonore" (F1) [which is the first known version of this opera work structured as three-acts and first performed in 1805].
	Beethoven's opera work identified as Op 72 (F1) *has elaboration* Beethoven's opera work "Fidelio" (F1), the two-act version of the opera work first performed in 1806 which constitutes a revision of the first version (Leonore).
	Beethoven's opera work identified as Op 72 (F1) *has elaboration* Beethoven's opera work "Fidelio" (F1), the two-act opera work first performed in 1814 which constitutes the final version of the opera.

R67 has part (forms part of): changed

from (OLD)

R67 has part (forms part of)

Domain:	F1 Work
Range:	F1 Work
Subproperty of:	F1 Work. R10 has member (is member of): F1 Work
Quantification:	(0,n:0,n)
Scope note:	This property associates an instance of F1 Work with another instance of F1 Work that forms part of it in a complementary role to other sibling parts, conceived at some point in time to form together a logical whole, such as the parts of a trilogy. This property is transitive. In contrast, the property R10 has member (is member of) may, for instance, also associate with the overall instance of F1 Work translations, adaptations and other derivative works that do not form a logical whole with sibling parts.
Examples:	Dante Alighieri's textual work entitled 'Divina Commedia' (F1) *R67 has part* Dante Alighieri's textual work entitled 'Inferno' (F1)
	Giovanni Battista Piranesi's graphic work entitled 'Carceri' (F1) *R67 has part* Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains' (F1)

to (NEW)

R67 has part (forms part of)

Domain:	F1 Work
Range:	F1 Work

|	
Subproperty of:	F1 Work. R10 has member (is member of): F1 Work
Quantification:	(0,n:0,n)
Scope note:	This property associates an instance of F1 Work with another instance of F1 Work that forms part of it in a complementary role to other sibling parts, conceived at some point in time to form together a logical whole, such as the parts of a trilogy. This property is transitive.
Examples:	Dante Alighieri's textual work entitled 'Divina Commedia' (F1) *R67 has part* Dante Alighieri's textual work entitled 'Inferno' (F1)
	Giovanni Battista Piranesi's graphic work entitled 'Carceri' (F1) *R67 has part* Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains' (F1)

NOTE:

The two different meanings of R10 represented using two different subproperties *has part* and *has elaboration.*

For *has part*, the parent work represents the union of parts. Any expression of a part is also included in expressions realizing the whole, but expressions of the whole are only partially realized in expressions of a part.

For *has elaboration*, the parent work represents the intersection of elaborations. Realization of the parent is always included in the realization of elaborations.
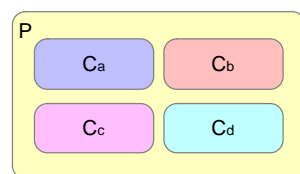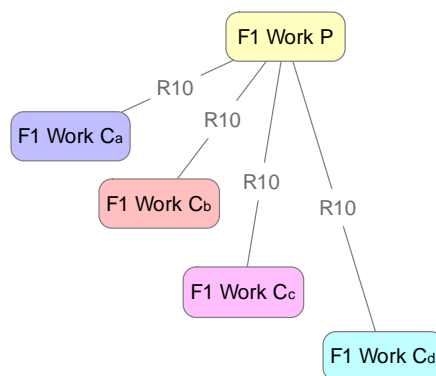
R67 has part
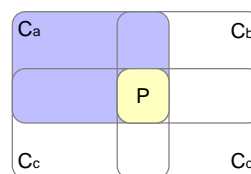
RXX has elaboration

TOPIC_2: Externalization, to finish

DECISION: The details of changes implemented in *Rnn has memorization* can be found in the Appendix.

- i.   The sig edited and accepted the scope note proposed by PR for **Rnn has memorization in (is memorization of)** [D: F28 Expression Creation; R: F2 Expression].
- ii. It was agreed that its label change to **Rnn was remembered in (contains memory of)**.
- iii. Instead of declaring **Rnn was remembered in** a subproperty of P16 used specific object [D: E7 Activity; R: E70 Thing] as proposed by PR, the sig opted to make it **isA P67i is referred to by** [D: E1 CRM Entity; R: E89 Propositional Object].

iv. **HW** to MR to come up with new examples –MD suggested that the examples might involve the Gospels; they were not put into writing in Aramaic –so they are clearly distinguished from incorporation relations

v. The scope note of **R20** underwent editing, to be distinguished from the new property. The details can be found in the Appendix.

TOPIC_3: replacing F25 Performance Plan by superclass E100 Activity Plan

DECISION: The sig went over the alternatives proposed by PR and then decided to deprecate R25 performed (was performed in) and use the CRMbase superproperty P33 used specific technique (was used by) [D: E7 Activity, R: E29 Design or Procedure] to declare the relation between a performance and the performance plan to which it conformed.

DECISION: Following the deprecation of F25 Performance Plan and R25 performed (was performed in) the fully developed path for *R66 included performed version of* needs to be edited accordingly. Since no reference can be made to **R25** and **F25**, the alternative of **P33** has to be offered and the link to the plan should be elaborated on through **socE2 Activity Plan** instead.

TOPIC_4: deprecate properties connecting to deprecated classes F26 and F21

DECISION: The sig accepted PR's proposal to deprecate properties R21 created and R22 created a realization and move the examples listed under them to **R17 created (was created by)** [D: F28 Expression Creation; R: F2 Expression] and **R19 created a realization of (was realized through)** [D: F28 Expression Creation R: F1 Work], respectively.

DECISION: the domain of **R19 created a realization of** must be set to F28 Expression Creation and **NOT** to F56 Externalization Event. **R19** must only be listed in the properties of **F28**. NOTE: Since R23 is deprecated, it should no longer appear in the subproperties of R19.

TOPIC_5: reproduction properties

The sig reviewed the HW by PR and accepted:

(i) The new example for F33 Reproduction Event:
The 2007 publication of Hubert Reeve's 'Malicorne: réflexions d'un observateur de la nature' published by Éditions du Seuil as number 179 in the series 'Points. Science' (ISBN 978-2-02-096760-0) (a reprint edition of the 1990 publication by Éditions du Seuil in the series 'Science ouverte' (ISBN 2-02-012644-3))

(ii) To list F33 as a subclass of F30 Manifestation Creation

(iii) To discard Rnn reproduced publication (was publication reproduced by) plus edit and reinstate R30 (same domain and range as Rnn reproduced publication).

HW: The sig appointed AF and FM to find examples regarding externalizations of instances of F2 Expression from Antiquity, in order to illustrate how authorship is established in Antiquity.

TOPIC_6: F54 Utilized Information Carrier

DECISION: The sig edited the scope note of F54 and move it to F5 Item instead. F54 is deprecated. Classes and properties formerly linked to F54 need to undergo editing (link to F5 instead).

DECISION: Regarding the proposal to move F54 to CRMdig, it was decided that the latter is still not mature enough to have another model's classes and/or properties link to it.

DECISION: The scope note for F5 Item changed

F5 Item

Subclass of: F54 Utilised Information Carrier [if F54 is removed, it would go directly to E18 Physical Thing]

Scope note: This class comprises physical objects (printed books, scores, CDs, DVDs, CD-ROMS, etc.) that were produced by (P186i) an industrial process involving a given instance of F3 Manifestation. As a result, all the instances of F5 Item associated with a given instance of F3 Manifestation are expected to carry the content defined in that instance of F3 Manifestation, although some or even all of them may happen to carry a content that significantly differs from it, due to either an accident in the course of industrial production, or subsequent physical modification or degradation.

The notion of F5 Item is only relevant with regard to the production process, from a bibliographic point of view. Cultural heritage institutions' holdings are a distinct notion: a holding certainly can be equal to an instance of F5 Item, but it also can be either "bigger" than one (e.g., when two instances of F5 Item are bound together (in the case of printed books), or physically united in any other way, or when an instance of F5 Item is enhanced through the addition of manuscript annotations, or any material that was not intended by the publisher, such as press clippings, dried flowers, etc.), or "smaller" than one (e.g., when a one-volume instance of F5 Item (in the case of printed books) is interleaved and rebound as two volumes, or when pages were torn away from it, or when one CD from a two-CD set is missing, etc.). From an operational point of view, cultural heritage institutions do not deal with instances of F5 Item, but with storage units. However, it was not deemed necessary to declare an additional class for the notion of Storage Unit. Storage units can be easily accounted for through the E19 Physical Object class from CIDOC CRM, and the relationships between storage units and instances of F5 Item through the P46 is composed of (forms part of) property from CIDOC CRM. If needed, an instance of E19 Physical Object can be typed as a storage unit through the P2 has type (is type of) property.

Examples:

- John Smith's copy of Charles Dickens's The Pickwick Papers published in 1986 by the Oxford Clarendon Press, ISBN 0-19-812631-X
- The exemplar of Samuel Beckett's Waiting for Godot published in 1956 by Faber and Faber that was once possessed by Edward Gordon Craig [who pasted a press clipping on it, so that the storage unit currently held by the National Library of France and identified by shelfmark '8-EGC-2044' consists of both this instance of F5 Item and the press clipping pasted by its former owner]
- The exemplar currently held by the Library of Congress, and identified by call number 'M3.3.H13 J4 1752 Case', of George Frideric Handel's The Choice of Hercules published in London by J. Walsh around 1751 [Note: this exemplar is bound with an exemplar of Jephtha, by the same composer, published in London by J. Walsh in 1752; these two distinct instances of F5 Item therefore make up a single storage unit, i.e., they both P146i forms part of the same instance of E19 Physical Object]

Properties: R7 is materialization of (is materialized in): F3 Manifestation

F5 Item

Subclass of: E18 Physical Thing

Scope note: This class comprises physical objects that carry one or more instances of F3 Manifestation to permit their distribution.

Examples:

- John Smith's copy of Charles Dickens's The Pickwick Papers published in 1986 by the Oxford Clarendon Press, ISBN 0-19-812631-X
- The exemplar of Samuel Beckett's Waiting for Godot published in 1956 by Faber and Faber that was once possessed by Edward Gordon Craig [who pasted a press clipping on it, so that the storage unit currently held by the National Library of France and identified by shelfmark '8-EGC-2044' consists of both this instance of F5 Item and the press clipping pasted by its former owner]
- The exemplar currently held by the Library of Congress, and identified by call number 'M3.3.H13 J4 1752 Case', of George Frideric Handel's The Choice of Hercules published in London by J. Walsh around 1751 [Note: this exemplar is bound with an exemplar of Jephtha, by the same composer, published in London by J. Walsh in 1752; these two distinct instances of F5 Item therefore make up a single storage unit, i.e., they both P146i forms part of the same instance of E19 Physical Object]

Properties: R7 is materialization of (is materialized in): F3 Manifestation

TOPIC_7: examples to be added

The sig reviewed PLB's HW on adding examples for R10 and R71.

DECISION: the examples for R10 has member were accepted; The sig also resolved to delete the example of Inferno. The details of the changes implemented to R10 can be found in the Appendix.

DECISION: the example for R71 specifies material part was accepted. The scope note underwent some editing. The details of the changes implemented to R71 can be found in the Appendix.

TOPIC_8: Confirm superproperty

R36 uses script conversion (is script conversion used in)

DECISION: This property has no known superproperty. Instead of declaring it to be a subproperty of P33, the full path that it shortcuts over should be listed.

The definition of R36 uses script conversion changed

FROM (OLD)

R36 uses script conversion (is script conversion used in)

Domain: F35 Nomen Use Statement
Range: F36 Script Conversion
Subproperty of: E7 Activity. P33 used specific technique (was used by): E29 Design or Procedure
Quantification: (0,1:0,n)

Scope note: This property associates an instance of F35 Nomen Use Statement with the instance of F36 Script Conversion that was used to create the instance of F12 Nomen referred to in the Nomen Use Statement. The source of this conversion may or may not be explicitly mentioned.

Is shortcut of: F35 Nomen Use Statement. R17 was created by (created): F28 Expression Creation. P33 used specific technique (was used by): E29 Design or Procedure.

Examples:
- '001 FRBNF120864715'…'100 $w.0..ba....$aDumFud0712-0770' [an instance of F35 Nomen Use Statement in INTERMARC format] (F35) *R36 uses script conversion* Pinyin (F36)
- '001 FRBNF119547493'…'100 w.0..barus.$aGončarova$mNatal'â Sergeevna$d1881-1962' [an instance of F35 Nomen Use Statement in INTERMARC format] (F35) *R36 uses script conversion* ISO 9:1995 (F36)

TO (NEW)

R36 uses script conversion (is script conversion used in)

Domain:	F35 Nomen Use Statement
Range:	F36 Script Conversion
Is shortcut of:	F35 Nomen Use Statement. R17 was created by (created): F28 Expression Creation. P33 used specific technique (was used by): E29 Design or Procedure.
Quantification:	(0,1:0,n)
Scope note:	This property associates an instance of F35 Nomen Use Statement with the instance of F36 Script Conversion that was used to create the instance of F12 Nomen referred to in the Nomen Use Statement. The source of this conversion may or may not be explicitly mentioned.

Examples:

- '001 FRBNF120864715'…'100 $w.0..ba....$aDumFud0712-0770' [an instance of F35 Nomen Use Statement in INTERMARC format] (F35) *R36 uses script conversion* Pinyin (F36)
- '001 FRBNF119547493'…'100 w.0..barus.$aGončarova$mNatal'â Sergeevna$d1881-1962' [an instance of F35 Nomen Use Statement in INTERMARC format] (F35) *R36 uses script conversion* ISO 9:1995 (F36)

Thursday, 27 February 2020

ISSUE 459: Modelling Principles (Intro to the CRM)

The sig went through the text of the introduction to the CRM section that has to do with the modelling principles and the examples supplied and reviewed the changes that the reviewers proposed. The sig only discussed parts of the text that had previously been judged unclear by the reviewing team. There were no issues regarding the rest of the document. The text in its final form appears in the appendix.

DECISION *(overall) regarding the introductory section of the CRM*: Given that the document still needs editing it won't be ready to be submitted at ISO before the 47th sig meeting. In view of that, it was decided that the next version (7.0) will become the official version for the sig community (because we can't rely on 6.2.1 with all the changes implemented over the last year). This version will appear in RDF as well. Extensive email votes will be held in the period leading up to the next meeting.

Following the next sig meeting, updates in the introduction will also be incorporated in the official version (v.7.1) which will then be submitted to ISO.

1. Reality, Knowledge Bases and CIDOC CRM (first paragraph)

DECISION: The sig appointed MD to rephrase the first paragraph (see below) of this section [**HW**]

    a. The reformulation should not refer to a "vocabulary" –to avoid confusion with thesauri (even though this is an unwarranted connection). Also, the reference to the definition of formal ontology by Guarino should be made into a footnote.

    b. It should be made clear what is meant by "non-technical audience", namely they are not necessarily computer scientists.

The CIDOC CRM is a formal ontology in the sense introduced by N. Guarino that is a specific **vocabulary** used to describe a part of reality, plus a first-order logical theory narrowing down the intended meaning of the **vocabulary** words (N. Guarino 1998). The syntax and formal semantics of this first-order theory are given in (Meghini & Doerr 2018), where the computational aspects are also discussed. The present document is intended for a **non-technical audience**; therefore, it focuses on the informal semantics and on the pragmatics

of the CIDOC CRM **vocabulary**, offering a detailed discussion of the main traits of the conceptualization underlying the CIDOC CRM through the basic usage patterns

DECISION: Editorial change, DELETE "descriptions of"

A formal ontology, such as the CIDOC CRM, constitutes a controlled language for talking about particulars. I.e., it provides ~~descriptions of~~ classes and properties for categorizing particulars as so-called "instances" in a way that their individuation, unity and relevant properties are as unambiguous as possible.

DECISION: provide links or references to the classes and properties' definitions mentioned throughout the introduction, given that they have not been previously introduced in this section of the document.

2. Knowledge Creation Process of Knowledge Base Contents

DECISION: This section has been renamed "Authorship of Knowledge Base Contents".

DECISION: The following sentence needs be further revised; it must be made clear that incompleteness of information is not the same as the existence of contradictory statements within a DB. CEO is on the rewrite [**HW**]. MD proposed that it be made into a footnote. Once it's been edited, it will be put up for an e-mail vote.

Statements in a KB may be in contradiction to the ontologically defined quantification of properties without the KB being broken or invalid in any sense, either because necessary properties are unknown or there exist good reasons to assume alternative values for properties with limited cardinality, be it by the same or by different maintainers

3. Extensions of CIDOC CRM

DECISION: Add a clause at the end of the second paragraph: "*These 'underdeveloped' concepts can be considered as candidate superclasses for compatible extensions, in particular for disciplines with a respective focus*. **Additions to the model are known as extensions, while the main model is known as CRMbase**."

a. **Mechanism 4**, conservative extension

DECISION: The sig edited the 4ᵗʰ, 5ᵗʰ & 6ᵗʰ paragraphs of this subsection. The edited text can be found below (edits are marked in boldface):

If case (2) should be documented and implemented in an extension module **separate from** the CIDOC CRM, it may come in conflict with the current way knowledge representation languages, such as RDF/OWL, treat it, because in formal logic changing the range or domain of a property is regarded **as** changing the ontological meaning **completely;** there is no distinction betwe**en the meaning of the property independent of domain and range and the specification of the domain and range**. It is, however, similar to what in logic is called a conservative extension of a theory, and necessary for an effective modular management of ontologies.

Therefore, for the interested reader, we describe here a definition of this case in terms of first order logic, which shows how modularity can formally be achieved:

Let us assume a property P defined with domain class A and range class C also holds for a domain class **B, superclass of A,** and a range class D, superclass of C, in the sense of its ontological meaning in the real world. We describe this situation by introducing an auxiliary formal property P', defined with domain class B and range class D, and apply the following logic:

$$A(x) \supset B(x)$$
$$C(x) \supset D(x)$$
$$P(x,y) \supset A(x)$$

$$P(x,y) \supset C(y)$$
$$P'(x,y) \supset B(x)$$
$$P'(x,y) \supset D(y)$$

Then, P' is a conservative extension of P if: $A(x) \wedge C(y) \wedge P'(x,y) \equiv P(x,y)$

In the Extensions of CIDOC CRM, in the third paragraph of mechanism 4, the following phrase was added:

> "This case is a monotonic extension and generally recommended, because it enables bottom-up evolution of the model"

DECISION: This addition resolves issue 298; which should be closed.

4. Monotonicity

DECISION: The sig deleted the phrase "Additions to the model are known as extensions, while the main model is known as CRMbase" from the 3rd paragraph, as it was moved to extensions, above. The paragraph now reads:

A first consequence of this commitment, at the level of the model, is that the CIDOC CRM aims to be monotonic in the sense of Domain Theory. That is to say, the existing CIDOC CRM constructs and the deductions made from them should remain valid and well-formed, even as new constructs are added by extensions to the CIDOC CRM. Any extensions should be, under this method, backwards compatible with previous models. The only exception to this rule arises when a previous construct is considered objectively incorrect by the domain experts and thus subjected to corrective revision. Adopting the principle of monotonicity has active consequences for the basic manner in which classes and properties are designed and declared in the CIDOC CRM. In particular, it forbids the declaration of complement classes, i.e. classes solely defined by excluding instances of some other classes

DECISION: hierarchical relations of specialization are to be constantly abbreviated by **IsA** throughout the text.

DECISION: editorial change: preposition selection

Such a system supports scholars being able to integrate all information about potentially relevant phenomena into the information system without forcing an over or under commitment **to** knowledge about the object.

5. **DECISION**: edit reference to paragraph "Knowledge generation process of Knowledge Base Contents" to "Authorship of Knowledge Base Contents". Disjointness

DECISION: The sig deleted any reference to possible worlds from the definition of disjointness. Necessity was expressed through modal operators. Only the opening sentence of this section changed. The new text reads:

Classes are disjoint if they cannot share any common instances at any time, past, present or future.

6. Introduction to the basic concepts

DECISION: paragraph 5., deletion of the last sentence as it appears verbatim in paragraph 6. The new text reads:

The real-world entities, which the event centric modelling of the CIDOC CRM aims to enable the accurate historical description of, are captured through E77 Persistent Item and its subclasses. E77 Persistent Item is used to describe entities that are relatively stable in form through the passage of time, maintaining a recognizable identity because their significant properties do not change. Specific subclasses of E77 Persistent Item can illustrate this point. E22 Human Made Object is used for the description of discrete, physical objects

having been produced by human action, such as an artwork or monument. An artwork or monument is persistent with regards to its physical constitution. So long as it retains its general physical form it is said to exist and to participate in the flow of historical events. E28 Conceptual Object is also used to describe persistent items but of a mental character. It is used to describe identifiable ideas that are named and form an object of historical discourse. Its identity conditions rely in having a carrier by which it can be recalled. The entities described by E77 Persistent Item are prone to change through human activity, biological, geological or environmental processes, but are regarded to continue to exist and be the same just as long as such changes do not alter their basic identity (essence) as defined in the scope note of the relevant class. ~~Continuous matter, such as atmosphere, or things lacking sufficient stability or differentiation, such as s=clouds, are not instances of E77 Persistent Item. Discourse about such items may be documented with concepts of the CIDOC CRM as observations in relation to things of persistent identity, such as places.~~

a. FIGURES
   i. Figure 1: properties of basic properties;
**DECISION**: The figure to be moved where its caption is.

   ii. Figure 2: Winkelmann sees the statue of Laocoon.
DECISION: The sig agreed with the diagram provided and the text explaining it (Appendix, Introduction to the basic concepts, figure 2). Minor suggested editions involve clarifying that the thumbnail pictures represent the person/object and do not stand for the visual items representing said entities (maybe in a footnote).

   iii. Figure depicting how the paths of Winkelmann and the statue of Laocoon cross in space and time (i.e. how the spacetime volumes of Winkelmann and Laocoon's statue meet).
DECISION: the figure is going to be incorporated in the CIDOC CRM definition (introduction to the basic concepts section). It will become **figure 3** in version 7.0. However, the specifics of the representation need be reworked, because the diagram in its current form gives the wrong impression regarding the direction of movements and the succession of movements from one place to the next.

HW: ML is to contact KD to provide a better visualization for that.
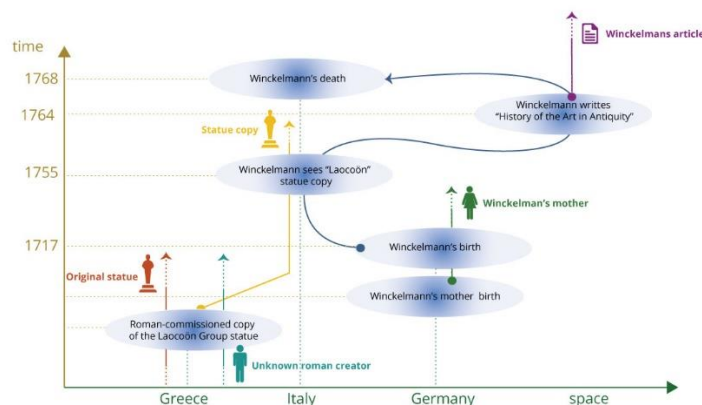
   iv. Figure 3 (current): Spatial information
DECISION: The sig reviewed the diagram and accepted it as is. It will be renamed "Figure 4: reasoning about spatial information".

NOTE: P157 is at rest relative to (provides reference space for) was deliberately omitted in the diagram on spatial information. It is represented in (current) figure 5.

        v.   Figure 4 (current): Temporal Information

DECISION: The sig edited the cardinalities for P4 has time span and P170 defines time.

- the cardinality of P4 has time-span [D: E2 Temporal Entity; R: E52 Time-Span] changed from (1,1:1,n) to (0,1:0,n), and
- the cardinality of P170 defines time [D: E61 Time Primitive; R: E52 Time-Span] changed from (1,1:0,n) to (0,1:0,n).

DECISION: The sig opted for representing properties P173 through P185 with only one arrow rather than two or more

DECISION: Figure 4 (current) will be renamed "fig.5 reasoning about temporal information"

        vi.   Figure 5 (current): reasoning with spacetime volumes

DECISION: The sig accepted the diagram as is, proviso the double arrow representing three properties among spacetime volumes. One arrow should suffice to represent all three properties (P10, P132, P133)

DECISION: Figure 5 (current) will be renamed "fig.6 reasoning with spacetime volumes"

ISSUE 457: harmonization of graphical documentation about CRM

NOTE: Issue 457 was discussed together with issue 471 below; discussion points mentioned here apply to 471 as well.

There is no need to create one diagram for all purposes, nor use the same software to produce a diagram representing the same information. In that sense, given the purpose of the diagram, one should be able to choose among one or the other software (.pptx vs draw.io, for instance). Being used for didactic purposes, means that the diagrams are not subject to limitations of space (printed page). On the other hand, the graphics in the CIDOC CRM definition must be readable and cannot exceed in size the printed page. In any case, more proposals can be made regarding the tools for making diagrams, the sig should be oriented towards open source tools.

There was a long discussion regarding features of the graphs; topics discussed involve:

- how to standardize color-code for classes,
- thickness of color to make the graphs readable,
- using single or double boxes to represent classes and how they 're instantiated,
- if the boxes for classes should be standard-size or of variable size (i.e. proportional to the size of the label of the class)
- if there should be a compact and an expanded version –related to user-needs (i.e. fit everything in one view or allow for multiple views)

DECISION: this issue is going to break into three issues, according to the intended goal of the diagrams.
   a)   one issue should deal with the diagrams present in the CIDOC CRM document (how they appear within the text),
   b)   another with diagrams for didactic purposes (to appear in the CRM site) and
   c)   another with the best way to represent the class hierarchy of CIDOC CRM (which will probably never appear as a whole in print –so maybe it is essentially didactic in purpose).

DECISION: the sig will revisit this after version 7.0 is released.

DECISION: instead of producing an endless wish-list, the sig will review some layout/color samples for figures **1** (properties of basic concepts), **2** (CRM encoding example: Winkelmann seeing Laocoön) and **5** (reasoning with spacetime volumes) of the Modelling Principles document, but **after** the release of CIDOC CRM v.7.0.

- The said diagrams must be presented both separately and embedded in the word document, so that they can be better appreciated in context.
- Regarding the layout of the graphs: they must follow a top-down, left-to-right orientation. Especially when it comes to properties, presentation must be top-down, to ensure that the reader understands how properties of the superclass are inherited by its subclasses.

The sig will ultimately decide among:
- Two styles: draw.io (or other) and .pptx
- Two color-codes: GB vs MD

by comparing the versions of each diagram (separate presentation vs embedded in the text) in draw.io and .pptx on the one hand, by one of the two proposed color-codes (MD vs GB). (8 versions per diagram).

- A horizontal isA hierarchy graph of CRM classes must also be produced and compared.

ISSUE 471: graphical examples

It was discussed together with issue 457 above.

DECISION: the sig decided to pause this issue until after the release of CIDOC CRM v.7.0 (so 7.1 probably).

ISSUE 470: CRM base introduction - updated graphs

DECISION: Issue 470 will be merged with issue 457 (harmonization of graphical documentation about CRM).

ISSUE 472: quantification of P169, P170, P171, P172

DECISION: The sig reviewed the cardinalities for properties P169, P170, P171 and P172.

- The cardinality of P169 defines spacetime volume [D: E95 Spacetime Primitive; R: E92 Spacetime Volume] is set to (1,1:0,n)
- the cardinality of P170 defines time [D: E61 Time Primitive; R: E52 Time-Span] is (0,1:0,n) (according to the decision reached in the context of issue 459; reviewing of figure 3)
- the cardinality of P171 at some place within [D: E53 Place, R: E94 Space Primitive] is (0,n:0,n)
- the cardinality of P172 contains [D: E53 Place, R: E94 Space Primitive] is (0,n:0,n)

DECISION: the sig edited the scope note of P171 while going through the quantification properties. The full path of P171 was edited and the definition of the property changed

FROM (old)

P171 at some place within

Domain:	E53 Place
Range:	E94 Space Primitive

Scope note: This property describes the maximum spatial extent within which an instance of E53 Place falls. Since instances of E53 Places may not have precisely known spatial extents, the CIDOC CRM supports statements about maximum spatial extents of E53 Places. This property allows an instance of an instance of E53 Places's maximum spatial extent (i.e. its outer boundary) to be assigned an E94 Space Primitive value.

P171 at some place within is a shortcut of the fully developed path *E53 Place, P89 falls within, E53 Place, P168 place is defined by, E94 Space Primitive* through a not represented declarative Place as defined in CRMgeo (Doerr and Hiebel 2013) to a Space Primitive

Examples:

the spatial extent of the Acropolis of Athens (E53) is *at some place within* POLYGON ((37.969172 23.720787, 37.973122 23.721495 37.972741 23.728994, 37.969299 23.729735, 37.969172 23.720787)) (E94)

In First Order Logic:

P171(x,y) ⊃ E53(x)
P171(x,y) ⊃ E94(y)

TO (new)

P171 at some place within

Domain: E53 Place

Range: E94 Space Primitive

Quantification: (0,n:0,n)

Scope note: This property describes the maximum spatial extent within which an instance of E53 Place falls. Since instances of E53 Places may not have precisely known spatial extents, the CIDOC CRM supports statements about maximum spatial extents of instances of E53 Place. This property allows an instance of E53 Place's maximum spatial extent (i.e. its outer boundary) to be assigned an instance of E94 Space Primitive value.

P171 at some place within is a shortcut of the fully developed path *E53 Place, P89 falls within, E53 Place, P168 place is defined by, E94 Space Primitive* through a declarative Place that is not explicitly documented to a Space Primitive: declarative places are defined in CRMgeo (Doerr and Hiebel 2013) –

Examples:

the spatial extent of the Acropolis of Athens (E53) is *at some place within* POLYGON ((37.969172 23.720787, 37.973122 23.721495 37.972741 23.728994, 37.969299 23.729735, 37.969172 23.720787)) (E94)

In First Order Logic:

P171(x,y) ⊃ E53(x)
P171(x,y) ⊃ E94(y)

The issue closed

ISSUE 467: space and time primitives are appellations

DECISION: the sig accepted MD's proposal to declare

- E94 Space Primitive, E61 Time Primitive and E95 Spacetime Primitive **subclasses** of **BOTH** E41 Appellation **AND** E59 Primitive Value
- E59 Primitive Value a subclass of E1 CRM Entity.

The issue closed

ISSUE 390: scope note of E94 Space Primitive

DECISION: The sig went over the decision to change the scope note for E94 Space Primitive. The decision was made over the 45th sig meeting, and it needed being ratified. Hence, the scope note for E94 Space Primitive now reads

Scope Note: This class comprises instances of E59 Primitive Value for space that should be implemented with appropriate validation, precision and references to spatial coordinate systems to express geometries on or relative to Earth, or on any other stable constellations of matter, relevant to cultural and scientific documentation.

An instance of E94 Space Primitive defines an instance of E53 Place in the sense of a declarative place as elaborated in CRMgeo (Doerr and Hiebel 2013), which means that the identity of the place is derived from its geometric definition. Such a declarative place may allow for the approximation of instances of E53 Place defined by the actual extent of some phenomenon, such as a settlement or a riverbed, or other forms of identification rather than by an instance of E94 Space Primitive. Note that using an instance of E94 Space Primitive for approximating the actual extent of some place always defines a (declarative) instance of E53 Place in its own right.

Definitions of instances of E53 Place using different spatial reference systems are always definitions of different instances of E53 Place.

Instances of E94 Space Primitive provide the ability to link CIDOC CRM encoded data to the kinds of geometries used in maps or Geoinformation systems. They may be used for visualization of the instances of E53 Place they define, in their geographic context and for computing topological relations between places based on these geometries. E94 Space Primitive is not further elaborated upon within this model. It is considered good practice to maintain compatibility with OGC standards.

The issue closed

ISSUE 434: new scope note for E52 Time-Span

The sig reviewed the HW by MD & CEO (scope note for E52) plus P4 has time-span and P170 defines time.

DECISION: The scope note for E52 Time-Span was accepted post editing. The same applies for P4 has time-span. The details can be found in the [appendix](#).

DECISION: P170 defines time was not accepted. MD volunteered to rewrite the scope note (i.e. expand on the notion of *defines time* and illustrate by means of an example). The sig reconvened on the 28th of February to review the new scope note and example (see [issue 434, continuation](#)).

ISSUE 466: example of approximates

DECISION: The sig reviewed the examples for P189 approximates (is approximated by) [HW by MD] and accepted them. The issue is closed.

The examples for P189 approximates (is approximated by) are:

- [40°31'17.9"N 21°15'48.3"E]   P189 *approximates* Kastoria, Greece, TGN ID: 7010880. (coordinates from [https://sws.geonames.org/735927 [5]](https://sws.geonames.org/735927))

- [40°31'00.1"N 21°16'00.1"E] P189 *approximates* Kastoria, Greece, TGN ID: 7010880. (coordinates from http://vocab.getty.edu/page/tgn/7010880

- 40°04'60.0"N 22°21'00.0"E P189 *approximates* Mount Olympus National Park, Greece (coordinates from https://www.geonames.org/6941814

ISSUE 465: FOL properties with range E55 Type

DECISION: the sig reviewed the HW by MD on the FOL axioms proposed by MD and did some editing. The following axioms were accepted

P125(x,y) iff (∃z)[E70(z) ∧ P16(x,z) ∧ P2(z,y)]

P186(x,y) ⊃ (∃z)[E24(z) ∧ P108(x,z) ∧ P2(z,y)]

P101(x,y) ⊃ (∃z)[E7(z) ∧ P16(z,x) ∧ P2(z,y)]

The axiom for P32 cannot be inferred, so it was dropped.

While discussing the inference for P101, the sig decided to start a new issue to change the scope of P101 in order to reflect the axiom above. The new issue must also cover the use of the terms General and Speccific, in all the labels where they appear and eradicate all ambiguities related to these terms.

The issue closed.

[NEW ISSUE]: scope note of P101 and proper definition of terms General and Specific

In the context of issue 465, upon discussing the inference for P101, the sig decided to start a new issue to change the scope of P101 in order to reflect the axiom above. The new issue must also cover the use of the terms General and Speccific, in all the labels where they appear and eradicate all ambiguities related to these terms. HW is assigned to SS to make sure the general specific property pairs are formulated in the same way.

Friday, 28 February 2020

Issue about procedure

PROPOSAL: GB volunteered to act as a secretary for the sig (help organize meetings content-wise) and offered to update issues on the site.

DECISION: Everyone present was in favor of that. It was decided that GB will from now on help coordinate projects and also flag issues that require the sig's attention. Which means that he will be granted rights to edit the CRM site.

ISSUE 434: Scope Note of E52 Time Span (continuation from day 3)

DECISION: The sig reviewed the new scope note for P170 [HW by MD] and accepted it post-editing. The details can be found in the appendix.

The issue closed.

ISSUE : HW BY CEO; CHECK SCOPE NOTES FOR CLASSES AND PROPERTIES OF THE CRM FOR INCONSISTENCIES.

DECISIONS (OVERALL):

a. the sig accepted all additions of *instance(s) of* prior to identifiers for classes across the document.

b. Examples missing from definitions of classes and properties: They have to be filled before the next CRM sig meeting. They are either to be treated in a separate issue or as part of this one.
CB shared with the sig a list of the classes and properties lacking examples.
HW to MD and SS to provide with examples.

1. *CLASSES*

E1 CRM Entity

DECISION: former conflict with E59 Primitive Value being in the scope of E1 CRM Entity is resolved, by explicitly declaring E59 isA E1.

DECISION: Scope note accepted post-editing by the sig.

E1 CRM Entity, changed

FROM (old)
E1 CRM Entity

Superclass of: E2 Temporal Entity
E52 Time-Span
E53 Place
E54 Dimension
E77 Persistent Item
E92 Spacetime Volume

Scope note: This class comprises all things in the universe of discourse of the CIDOC Conceptual Reference Model.

It is an abstract concept providing for three general properties:
1. Identification by name or appellation, and in particular by a preferred identifier
2. Classification by type, allowing further refinement of the specific subclass an instance belongs to
3. Attachment of free text for the expression of anything not captured by formal properties
With the exception of E59 Primitive Value, all other classes within the CIDOC CRM are directly or indirectly specialisations of E1 CRM Entity.

Examples:
- the earthquake in Lisbon 1755 (E5) (Chester, 2001)

In First Order Logic:
E1(x)

Properties:
P1 is identified by (identifies): E41 Appellation
P2 has type (is type of): E55 Type
P3 has note: E62 String
(P3.1 has type: E55 Type)
P48 has preferred identifier (is preferred identifier of): E42 Identifier
P137 exemplifies (is exemplified by): E55 Type
(P137.1 in the taxonomic role: E55 Type)

E1 CRM Entity

Superclass of: [E2](#) Temporal Entity

[E52](#) Time-Span

[E53](#) Place

[E54](#) Dimension

[E59](#) Primitive Value

[E77](#) Persistent Item

[E92](#) Spacetime Volume

Scope note: This class comprises all things in the universe of discourse of the CIDOC Conceptual Reference Model.

It is an abstract concept providing for three general properties:
1. Identification by name or appellation, and in particular by a preferred identifier
2. Classification by type, allowing further refinement of the specific subclass an instance belongs to
3. Attachment of free text and other unstructured data for the expression of anything not captured by formal properties

All other classes within the CIDOC CRM are directly or indirectly specializations of E1 CRM Entity.

Examples:

- the earthquake in Lisbon 1755 (E5) (Chester, 2001)

In First Order Logic:

E1(x)

Properties:

P1 is identified by (identifies): E41 Appellation

P2 has type (is type of): E55 Type

P3 has note: E62 String

(P3.1 has type: E55 Type)

P48 has preferred identifier (is preferred identifier of): E42 Identifier

P137 exemplifies (is exemplified by): E55 Type

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

E2 Temporal Entity

DECISION: the sig resolved the comments made by CEO, did some editing to the scope note and accepted it for the next official release.

The scope note changed

FROM (old)

E2 Temporal Entity

Subclass of: E1 CRM Entity

Superclass of: E3 Condition State

E4 Period

Scope note: This class comprises all phenomena, such as the instances of E4 Periods, E5 Events and states, which happen over a limited extent in time. This extent in time must be contiguous, i.e., without gaps. In case the defining kinds of phenomena for an instance of E2 Temporal Entity cease to happen, and occur later again at another time, we regard that the former instance of E2 Temporal Entity has ended and a new instance has come into existence. In more intuitive terms, the same event cannot happen twice.

In some contexts, these are also called perdurants. This class is disjoint from E77 Persistent Item. This is an abstract class that typically has no direct instances. E2 Temporal Entity is specialized into E4 Period, which applies to a particular geographic area (defined with a greater or lesser degree of precision), and E3 Condition State, which applies to instances of E18 Physical Thing.

Examples:
- Bronze Age (E4) (Childe, 1963)
- the earthquake in Lisbon 1755 (E5) (Chester, 2001)
- the Peterhof Palace near Saint Petersburg being in ruins from 1944 – 1946 (E3) (Maddox, 2015)

In First Order Logic:

$$E2(x) \supset E1(x)$$

Properties:

P4 has time-span (is time-span of): E52 Time-Span
P173 starts before or at the end of (ends with or after the start of): E2 Temporal Entity
P174 starts before (starts after the start of): E2 Temporal Entity
P175 starts before or with the start of (starts with or after the start of) : E2 Temporal Entity
P176 starts before the start of (starts after the start of): E2 Temporal Entity
P182 ends before or at the start of (starts with or after the end of) : E2 Temporal Entity
P183 ends before the start of (starts after the end of) : E2 Temporal Entity
P184 ends before or with the end of (ends with or after the end of) : E2 Temporal Entity
P185 ends before the end of (ends after the end of): E2 Temporal Entity

TO (new)

E2 Temporal Entity

Subclass of: E1 CRM Entity
Superclass of: E3 Condition State
                 E4 Period

Scope note: This class comprises all phenomena, such as the instances of E4 Periods and E5 Events, which happen over a limited extent in time. This extent in time must be contiguous, i.e., without gaps. In case the defining kinds of phenomena for an instance of E2 Temporal Entity cease to happen, and occur later again at another time, we regard that the former instance of E2 Temporal Entity has ended and a new instance has come into existence. In more intuitive terms, the same event cannot happen twice.

In some contexts, such phenomena are also called perdurants. This class is disjoint from E77 Persistent Item and is an abstract class that typically has no direct instances. E2 Temporal Entity is specialized into E4 Period, which applies to a particular geographic area (defined with a greater or lesser degree of precision), and E3 Condition State, which applies to instances of E18 Physical Thing.

Examples:

- Bronze Age (E4)   (Childe, 1963)
- the earthquake in Lisbon 1755 (E5) (Chester, 2001)
- the Peterhof Palace near Saint Petersburg being in ruins from 1944 – 1946 (E3) (Maddox, 2015)

In First Order Logic:

$E2(x) \supset E1(x)$

Properties:

P4 has time-span (is time-span of): E52 Time-Span
P173 starts before or at the end of (ends with or after the start of): E2 Temporal Entity
P174 starts before (starts after the start of): E2 Temporal Entity
P175 starts before or with the start of (starts with or after the start of) : E2 Temporal Entity
P176 starts before the start of (starts after the start of): E2 Temporal Entity
P182 ends before or at the start of (starts with or after the end of) : E2 Temporal Entity
P183 ends before the start of (starts after the end of) : E2 Temporal Entity
P184 ends before or with the end of (ends with or after the end of) : E2 Temporal Entity
P185 ends before the end of (ends after the end of): E2 Temporal Entity

E4 Period

DECISION: the paragraph below, was marked *to be deleted*. The sig decided to delete it for the moment, and assigned MD [**HW**] to check if it was alright to delete it after all.

> Consequently, an instance of E4 Period may occupy a number of disjoint spacetime volumes, however there must not be a discontinuity in the timespan covered by these spacetime volumes. This means that an instance of E4 Period must be contiguous in time. If it has ended in all areas, it has ended as a whole. However, it may end in one area before another, such as in the Polynesian migration, and it continues as long as it is ongoing in at least one area

DECISION: the reference to the STV in the introduction must be reintroduced.

The definition of E4 Period changed

FROM (old)
E4 Period

Subclass of: E2 Temporal Entity
Subclass of   E92 Spacetime volume
Superclass of: E5 Event

Scope note: This class comprises sets of coherent phenomena or cultural manifestations occurring in time and space.

It is the social or physical coherence of these phenomena that identify an E4 Period and not the associated spatiotemporal extent. This extent is only the "ground" or space in an abstract physical sense that the actual process of growth, spread and retreat has covered. Consequently, different periods can overlap and coexist in time and space, such as when a nomadic culture exists in the same area and time as a sedentary culture. This also means that overlapping land use rights, common among first nations, amounts to overlapping periods.

Often, this class is used to describe prehistoric or historic periods such as the "Neolithic Period", the "Ming Dynasty" or the "McCarthy Era", but also geopolitical units and activities of settlements are regarded as special cases of E4 Period. However, there are no assumptions about the scale of the associated phenomena. In particular all events are seen as synthetic processes consisting of coherent phenomena. Therefore, E4 Period is a

superclass of E5 Event. For example, a modern clinical birth, an instance of E67 Birth, can be seen as both a single event, i.e., an instance of E5 Event, and as an extended period, i.e., an instance of E4 Period, that consists of multiple physical processes and complementary activities performed by multiple instances of E39 Actor.

As the actual extent of an instance of E4 Period in spacetime we regard the trajectories of the participating physical things during their participation in an instance of E4 Period. This includes the open spaces via which these things have interacted and the spaces by which they had the potential to interact during that period or event in the way defined by the type of the respective period or event. Examples include the air in a meeting room transferring the voices of the participants. Since these phenomena are fuzzy, we assume the spatiotemporal extent to be contiguous, except for cases of phenomena spreading out over islands or other separated areas, including geopolitical units distributed over disconnected areas such as islands or colonies.

Whether the trajectories necessary for participants to travel between these areas are regarded as part of the spatiotemporal extent or not has to be decided in each case based on a concrete analysis, taking use of the sea for other purposes than travel, such as fishing, into consideration. One may also argue that the activities to govern disconnected areas imply travelling through spaces connecting them and that these areas hence are spatially connected in a way, but it appears counterintuitive to consider for instance travel routes in international waters as extensions of geopolitical units.

~~Consequently, an instance of E4 Period may occupy a number of disjoint spacetime volumes, however there must not be a discontinuity in the timespan covered by these spacetime volumes. This means that an instance of E4 Period must be contiguous in time. If it has ended in all areas, it has ended as a whole. However, it may end in one area before another, such as in the Polynesian migration, and it continues as long as it is ongoing in at least one area~~

We model E4 Period as a subclass of E2 Temporal Entity and of E92 Spacetime Volume. The latter is intended as a phenomenal spacetime volume as defined in CIDOC CRMgeo (Doerr and Hiebel, 2013). By virtue of this multiple inheritance we can discuss the physical extent of an instance of E4 Period without representing each instance of it together with an instance of its associated spacetime volume. This model combines two quite different kinds of substance: an instance of E4 Period is a phenomenon, while an instance of E92 Spacetime Volume is an aggregation of points in spacetime. However, the real spatiotemporal extent of an instance of E4 Period is regarded to be unique to it due to all its details and fuzziness; its identity and existence depends uniquely on the identity of the instance of E4 Period. Therefore, this multiple inheritance is unambiguous and effective and furthermore corresponds to the intuitions of natural language.

There are two different conceptualisations of 'artistic style', defined either by physical features or by historical context. For example, "Impressionism" can be viewed as a period lasting from approximately 1870 to 1905 during which paintings with particular characteristics were produced by a group of artists that included (among others) Monet, Renoir, Pissarro, Sisley and Degas. Alternatively, it can be regarded as a style applicable to all paintings sharing the characteristics of the works produced by the Impressionist painters, regardless of historical context. The first interpretation is an instance of E4 Period, and the second defines morphological object types that fall under E55 Type.

A geopolitical unit as a specific case of an instance of E4 Period is the set of activities and phenomena related to the claim of power, the consequences of belonging to a jurisdictional area and an administrative system that establishes a geopolitical unit. Examples from the modern period are countries or administrative areas of countries such as districts whose actions and structures define activities and phenomena in the area that they intend to

govern. The borders of geopolitical units are often defined in contracts or treaties although they may deviate from the actual practice. The spatiotemporal properties of Geopolitical units can be modelled through the properties inherited from E92 Spacetime Volume.

Another specific case of an E4 Period is the actual extent of the set of activities and phenomena as evidenced by their physical traces that define a settlement, such as the populated period of Nineveh.

Examples:

- Jurassic (Hallam, 1975)
- Populated Period of Nineveh
- Imperial Rome under Marcus Aurelius
- European Bronze Age (Harrison, c2004)
- Italian Renaissance (Macdonald, 1992)
- Thirty Years War (Lee, 1991)
- Sturm und Drang (Berkoff, 2013)
- Cubism (Cox, 2000)

In First Order Logic:

E4(x) ⊃ E2(x)
E4(x) ⊃ E92(x)

Properties:

P7 took place at (witnessed): E53 Place
P8 took place on or within (witnessed): E18 Physical Thing
P9 consists of (forms part of): E4 Period

TO (new)

E4 Period

Subclass of: E2 Temporal Entity
Subclass of   E92 Spacetime volume
Superclass of: E5 Event

Scope note: This class comprises sets of coherent phenomena or cultural manifestations occurring in time and space.

It is the social or physical coherence of these phenomena that identify an instance of E4 Period and not the associated spatiotemporal extent. This extent is only the "ground" or space in an abstract physical sense that the actual process of growth, spread and retreat has covered. Consequently, different periods can overlap and coexist in time and space, such as when a nomadic culture exists in the same area and time as a sedentary culture. This also means that overlapping land use rights, common among first nations, amounts to overlapping periods.

Often, this class is used to describe prehistoric or historic periods such as the "Neolithic Period", the "Ming Dynasty" or the "McCarthy Era", but also geopolitical units and activities of settlements are regarded as special cases of E4 Period. However, there are no assumptions about the scale of the associated phenomena. In particular all events are seen as synthetic processes consisting of coherent phenomena. Therefore, E4 Period is a superclass of E5 Event. For example, a modern clinical birth, an instance of E67 Birth, can be seen as both a single event, i.e., an instance of E5 Event, and as an extended period, i.e., an

instance of E4 Period, that consists of multiple physical processes and complementary activities performed by multiple instances of E39 Actor.

As the actual extent of an instance of E4 Period in spacetime we regard the trajectories of the participating physical things during their participation in an instance of E4 Period. This includes the open spaces via which these things have interacted and the spaces by which they had the potential to interact during that period or event in the way defined by the type of the respective period or event. Examples include the air in a meeting room transferring the voices of the participants. Since these phenomena are fuzzy, we assume the spatiotemporal extent to be contiguous, except for cases of phenomena spreading out over islands or other separated areas, including geopolitical units distributed over disconnected areas such as islands or colonies.

Whether the trajectories necessary for participants to travel between these areas are regarded as part of the spatiotemporal extent or not has to be decided in each case based on a concrete analysis, taking use of the sea for other purposes than travel, such as fishing, into consideration. One may also argue that the activities to govern disconnected areas imply travelling through spaces connecting them and that these areas hence are spatially connected in a way, but it appears counterintuitive to consider for instance travel routes in international waters as extensions of geopolitical units.

We model E4 Period as a subclass of E2 Temporal Entity and of E92 Spacetime Volume. The latter is intended as a phenomenal spacetime volume as defined in CIDOC CRMgeo (Doerr and Hiebel, 2013). By virtue of this multiple inheritance we can discuss the physical extent of an instance of E4 Period without representing each instance of it together with an instance of its associated spacetime volume. This model combines two quite different kinds of substance: an instance of E4 Period is a phenomenon, while an instance of E92 Spacetime Volume is an aggregation of points in spacetime. However, the real spatiotemporal extent of an instance of E4 Period is regarded to be unique to it due to all its details and fuzziness; its identity and existence depends uniquely on the identity of the instance of E4 Period. Therefore, this multiple inheritance is unambiguous and effective and furthermore corresponds to the intuitions of natural language.

The typical use of this class in cultural heritage documentation is for documenting cultural and artistic periods. There are two different conceptualizations of 'artistic style', defined either by physical features or by historical context. For example, "Impressionism" can be viewed as a period in the European sphere of influence lasting from approximately 1870 to 1905 during which paintings with particular characteristics were produced by a group of artists that included (among others) Monet, Renoir, Pissarro, Sisley and Degas. Alternatively, it can be regarded as a style applicable to all paintings sharing the characteristics of the works produced by the Impressionist painters, regardless of historical context. The first interpretation is an instance of E4 Period, and the second defines morphological object types that fall under E55 Type.

A geopolitical unit as a specific case of an instance of E4 Period is the set of activities and phenomena related to the claim of power, the consequences of belonging to a jurisdictional area and an administrative system that establishes a geopolitical unit. Examples from the modern period are countries or administrative areas of countries such as districts whose actions and structures define activities and phenomena in the area that they intend to govern. The borders of geopolitical units are often defined in contracts or treaties although they may deviate from the actual practice. The spatiotemporal properties of Geopolitical units can be modelled through the properties inherited from E92 Spacetime Volume.

Another specific case of an instance of E4 Period is the actual extent of the set of activities and phenomena as evidenced by their physical traces that define a settlement, such as the populated period of Nineveh.

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- European Bronze Age (Harrison, c2004)
- Italian Renaissance (Macdonald, 1992)
- Thirty Years War (Lee, 1991)
- Sturm und Drang (Berkoff, 2013)
- Cubism (Cox, 2000)

In First Order Logic:

E4(x) ⊃ E2(x)
E4(x) ⊃ E92(x)

Properties:

P7 took place at (witnessed): E53 Place
P8 took place on or within (witnessed): E18 Physical Thing
P9 consists of (forms part of): E4 Period

E6 Destruction

DECISION: The sig accepted CEO & GB's proposal to ignore the comment on E6. The definition of E6 Destruction remains as it were in v.6.2.7/8.

E11 Modification

DECISION: The sig accepted CEO's edit (i.e. deletion of "all" from first sentence) on the scope note. E11 Modification changed

FROM (old)

E11 Modification

Subclass of:	E7 Activity
Superclass of:	E12 Production
	E79 Part Addition
	E80 Part Removal

Scope note: This class comprises all instances of E7 Activity that create, alter or change instances of E24 Physical Human-Made Thing.

This class includes the production of an item from raw materials, and other so far undocumented objects, and the preventive treatment or restoration of an object for conservation.

Since the distinction between modification and production is not always clear, modification is regarded as the more generally applicable concept. This implies that some items may be consumed or destroyed in an instance of E11 Modification, and that others may be produced as a result of it. An event should also be documented using an instance of E81 Transformation if it results in the destruction of one or more objects and the simultaneous

production of others using parts or material from the originals. In this case, the new items have separate identities.

If the instance of E29 Design or Procedure utilized for the modification prescribes the use of specific materials, they should be documented using property *P68 foresees use of (use foreseen by):* E57 Material of E29 Design or Procedure, rather than via *P126 employed (was employed in*): E57 Material.

Examples:

- the construction of the SS Great Britain (E12) (Gregor, 1971)
- the impregnation of the Vasa warship in Stockholm for preservation after 1956 (Håfors, c2010)
- the transformation of the Enola Gay into a museum exhibit by the National Air and Space Museum in Washington DC between 1993 and 1995 (E12, E81) (Yakel, 2000)
- the last renewal of the gold coating of the Toshogu shrine in Nikko, Japan (Cali and Dougil, 2012)

In First Order Logic:

E11(x) ⊃ E7(x)

Properties:

P31 has modified (was modified by): E18 Physical Thing
P126 employed (was employed in: E57 Material

TO (new)
E11 Modification

Subclass of: E7 Activity

Superclass of: E12 Production
                 E79 Part Addition
                 E80 Part Removal

Scope note: This class comprises instances of E7 Activity that create, alter or change instances of E24 Physical Human-Made Thing.

This class includes the production of an item from raw materials, and other so far undocumented objects, and the preventive treatment or restoration of an object for conservation.

Since the distinction between modification and production is not always clear, modification is regarded as the more generally applicable concept. This implies that some items may be consumed or destroyed in an instance of E11 Modification, and that others may be produced as a result of it. An event should also be documented using an instance of E81 Transformation if it results in the destruction of one or more objects and the simultaneous production of others using parts or material from the originals. In this case, the new items have separate identities.

If the instance of E29 Design or Procedure utilized for the modification prescribes the use of specific materials, they should be documented using property *P68 foresees use of (use foreseen by):* E57 Material of E29 Design or Procedure, rather than via *P126 employed (was employed in*): E57 Material.

Examples:

- the construction of the SS Great Britain (E12) (Gregor, 1971)

- the impregnation of the Vasa warship in Stockholm for preservation after 1956 (Håfors, 2010)
- the transformation of the Enola Gay into a museum exhibit by the National Air and Space Museum in Washington DC between 1993 and 1995 (E12, E81) (Yakel, 2000)
- the last renewal of the gold coating of the Toshogu shrine in Nikko, Japan (Cali and Dougil, 2012)

In First Order Logic:

$$E11(x) \supset E7(x)$$

Properties:

P31 has modified (was modified by): E18 Physical Thing
P126 employed (was employed in: E57 Material

E13 Attribute Assignment

DECISION: The sig accepted CEO's edit (i.e. introduction of "instances of" in the phrase *the use of 13 Attribute Assignment marks the fact, that …*) on the scope note. E13 Attribute Assignment changed

FROM (old)

E13 Attribute Assignment

Subclass of: E7 Activity
Superclass of: E14 Condition Assessment
                  E15 Identifier Assignment
                  E16 Measurement
                  E17 Type Assignment

Scope note: This class comprises the actions of making assertions about one property of an object or any single relation between two items or concepts. The type of the property asserted to hold between two items or concepts can be described by the property P177 assigned property type: E55 Type.

For example, the class describes the actions of people making propositions and statements during certain scientific/scholarly procedures, e.g. the person and date when a condition statement was made, an identifier was assigned, the museum object was measured, etc. Which kinds of such assignments and statements need to be documented explicitly in structures of a schema rather than free text, depends on whether this information should be accessible by structured queries.

This class allows for the documentation of how the respective assignment came about, and whose opinion it was. Note that all instances of properties described in a knowledge base are the opinion of someone. Per default, they are the opinion of the team maintaining the knowledge base. This fact must not individually be registered for all instances of properties provided by the maintaining team, because it would result in an endless recursion of whose opinion was the description of an opinion. Therefore, the use of E13 Attribute Assignment marks the fact, that the maintaining team is in general neutral to the validity of the respective assertion, but registers someone else's opinion and how it came about.

All properties assigned in such an action can also be seen as directly relating the respective pair of items or concepts. Multiple use of instances of E13 Attribute Assignment may possibly lead to a collection of contradictory values.

All cases of properties in this model that are also described indirectly through a subclass of E13 Attribute Assignment are characterised as "short cuts" of a path via this subclass. This redundant modelling of two alternative views is preferred because many implementations may have good reasons to model either the action of assertion or the short cut, and the relation between both alternatives can be captured by simple rules.

Examples:
- the assessment of the current ownership of Martin Doerr's silver cup in February 1997

In First Order Logic:

E13(x) ⊃ E7(x)

Properties:

P140 assigned attribute to (was attributed by): E1 CRM Entity
P141 assigned (was assigned by): E1 CRM Entity
P177 assigned property type E55 Type

TO (new)

E13 Attribute Assignment

Subclass of: E7 Activity
Superclass of: E14 Condition Assessment
E15 Identifier Assignment
E16 Measurement
E17 Type Assignment

Scope note: This class comprises the actions of making assertions about one property of an object or any single relation between two items or concepts. The type of the property asserted to hold between two items or concepts can be described by the property P177 assigned property type: E55 Type.

For example, the class describes the actions of people making propositions and statements during certain scientific/scholarly procedures, e.g. the person and date when a condition statement was made, an identifier was assigned, the museum object was measured, etc. Which kinds of such assignments and statements need to be documented explicitly in structures of a schema rather than free text, depends on whether this information should be accessible by structured queries.

This class allows for the documentation of how the respective assignment came about, and whose opinion it was. Note that all instances of properties described in a knowledge base are the opinion of someone. Per default, they are the opinion of the team maintaining the knowledge base. This fact must not individually be registered for all instances of properties provided by the maintaining team, because it would result in an endless recursion of whose opinion was the description of an opinion. Therefore, the use of instances of E13 Attribute Assignment marks the fact, that the maintaining team is in general neutral to the validity of the respective assertion, but registers someone else's opinion and how it came about.

All properties assigned in such an action can also be seen as directly relating the respective pair of items or concepts. Multiple use of instances of E13 Attribute Assignment may possibly lead to a collection of contradictory values.

All cases of properties in this model that are also described indirectly through a subclass of E13 Attribute Assignment are characterised as "short cuts" of a path via this subclass. This redundant modelling of two alternative views is preferred because many implementations may have good reasons to model either the action of assertion or the short cut, and the relation between both alternatives can be captured by simple rules.

Examples:

- the assessment of the current ownership of Martin Doerr's silver cup in February 1997

In First Order Logic:

        E13(x) ⊃ E7(x)

Properties:

        P140 assigned attribute to (was attributed by): E1 CRM Entity
        P141 assigned (was assigned by): E1 CRM Entity
            P177 assigned property type E55 Type

E14 Condition Assessment

DECISION: The sig agreed that an improvement of the scope note would be useful, however, due to time limitations, the scope note should do as is.

HW (but **not** for version 7.0): The sig appointed MD to do the rewrite. TV, MA & DF can also be involved in this HW.

E16 Measurement

DECISION: The sig did some editorial work on the scope note, to make it more legible. The scope note changed

FROM (old)
E16 Measurement

Subclass of: E13 Attribute Assignment

Scope note: This class comprises actions measuring quantitative physical properties and other values that can be determined by a systematic, objective procedure of direct observation of particular states of physical reality. Properties of instances of E90 Symbolic Object may be measured by observing some of their representative carriers which may or may not be named explicitly. In the former case, the property P16 used specific object (was used for): E70 Thing should be used to specify the information carriers used as empirical basis for the measurement activity.

               Examples include measuring the nominal monetary value of a collection of coins or the running time of a movie on a specific video cassette.

               The E16 Measurement may use simple counting or tools, such as yardsticks or radiation detection devices. The interest is in the method and care applied, so that the reliability of the result may be judged at a later stage, or research continued on the associated documents. The date of the event is important for dimensions, which may change value over time, such as the length of an object subject to shrinkage. Methods and devices employed should be

associated with instances of E16 Measurement by properties such as P33 used specific technique: E29 Design or Procedure, P125 used object of type: E55 Type, P16 used specific object (was used for): E70 Thing, whereas basic techniques such as "carbon 14 dating" should be encoded using P2 has type (is type of): E55 Type. Details of methods and devices reused or reusable in other instances of E16 Measurement should be documented for these entities rather than the measurements themselves, whereas details of particular execution may be documented by free text or by instantiating adequate sub-activities, if the detail may be of interest for an overarching query.

Regardless whether a measurement is made by an instrument or by human senses, it represents the initial transition from physical reality to information without any other documented information object in between within the reasoning chain that would represent the result of the interaction of the observer or device with reality. Therefore, inferring properties of depicted items using image material, such as satellite images, is not regarded as an instance of E16 Measurement, but as a subsequent instance of E13 Attribute Assignment. Rather, only the production of the images, understood as arrays of radiation intensities, is regarded as an instance of E16 Measurement. The same reasoning holds for other sensor data.

Examples:

- measurement of height of silver cup 232 on the 31st August 1997
- the carbon 14 dating of the "Schoeninger Speer II" in 1996 [an about 400.000 years old Palaeolithic complete wooden spear found in Schoeningen, Niedersachsen, Germany in 1995] (Kouwenhoven, 1997)
- The pixel size of the jpeg version of Titian's painting Bacchus and Ariadne from 1520–3, as freely downloadable from the National Gallery in London's web page <https://www.nationalgallery.org.uk/paintings/titian-bacchus-and-ariadne> is 581600 pixels.
- The scope note of E21 Person in the Definition of the CIDOC Conceptual Reference Model Version 5.0.4 as downloaded from <http://www.cidoc-crm.org/sites/default/files/cidoc_crm_version_5.0.4.pdf> consists of 77 words.

In First Order Logic:

E16(x) ⊃ E13(x)

Properties:

P39 measured (was measured by): E1 CRM Entity
P40 observed dimension (was observed in): E54 Dimension

TO (new)

E16 Measurement

Subclass of: E13 Attribute Assignment

Scope note: This class comprises actions measuring quantitative physical properties and other values that can be determined by a systematic, objective procedure of direct observation of particular states of physical reality. Properties of instances of E90 Symbolic Object may be measured by observing some of their representative carriers which may or may not be named explicitly. In the case that the carrier can be named, the property *P16 used specific object (was used for)* should be used to indicate the instance(s) of E18 Physical Thing that used as the empirical basis for the measurement activity.

Examples include measuring the nominal monetary value of a collection of coins or the running time of a movie on a specific video cassette.

The E16 Measurement may use simple counting or tools, such as yardsticks or radiation detection devices. The interest is in the method and care applied, so that the reliability of the result may be judged at a later stage, or research continued on the associated documents. The date of the event is important for dimensions, which may change value over time, such as the length of an object subject to shrinkage. Methods and devices employed should be associated with instances of E16 Measurement by properties such as P33 used specific technique: E29 Design or Procedure, P125 used object of type: E55 Type, P16 used specific object (was used for): E70 Thing, whereas basic techniques such as "carbon 14 dating" should be encoded using P2 has type (is type of): E55 Type. Details of methods and devices reused or reusable in other instances of E16 Measurement should be documented for these entities rather than the measurements themselves, whereas details of particular execution may be documented by free text or by instantiating adequate sub-activities, if the detail may be of interest for an overarching query.

Regardless whether a measurement is made by an instrument or by human senses, it represents the initial transition from physical reality to information without any other documented information object in between within the reasoning chain that would represent the result of the interaction of the observer or device with reality. Therefore, inferring properties of depicted items using image material, such as satellite images, is not regarded as an instance of E16 Measurement, but as a subsequent instance of E13 Attribute Assignment. Rather, only the production of the images, understood as arrays of radiation intensities, is regarded as an instance of E16 Measurement. The same reasoning holds for other sensor data.

Examples:

- measurement of height of silver cup 232 on the 31st August 1997
- the carbon 14 dating of the "Schoeninger Speer II" in 1996 [an about 400.000 years old Palaeolithic complete wooden spear found in Schoeningen, Niedersachsen, Germany in 1995] (Kouwenhoven, 1997)
- The pixel size of the jpeg version of Titian's painting Bacchus and Ariadne from 1520–3, as freely downloadable from the National Gallery in London's web page <https://www.nationalgallery.org.uk/paintings/titian-bacchus-and-ariadne> is 581600 pixels.
- The scope note of E21 Person in the Definition of the CIDOC Conceptual Reference Model Version 5.0.4 as downloaded from <http://www.cidoc-crm.org/sites/default/files/cidoc_crm_version_5.0.4.pdf> consists of 77 words.

In First Order Logic:

E16(x) ⊃ E13(x)

Properties:

P39 measured (was measured by): E1 CRM Entity
P40 observed dimension (was observed in): E54 Dimension

E25 Human-Made Feature

DECISION: The sig fixed a typo in the scope note. The scope note changed

FROM (old)

E25 Human-Made Feature

Subclass of: E24 Physical Human-Made Thing
                E26 Physical Feature

Scope Note: This class comprises physical features that are purposely created by human activity, such as scratches, artificial caves, artificial water channels, etc. In particular, it includes the information encoding features on mechanical or digital carriers.

No assumptions are made as to the extent of modification required to justify regarding a feature as human-made. For example, rock art or even "cup and ring" carvings on bedrock a regarded as types of E25 Human-Made Feature.

Examples:

- the Manchester Ship Canal (Famie, 1980)
- Michael Jackson's nose following plastic surgery
- The laser-readable "pits" engraved June 2014 on Martin Doerr's CD-R, copying songs of Edith Piaf's.
- The carved letters on the Rosetta Stone

In First Order Logic:

E25(x) ⊃ E24(x)
E25(x) ⊃ E26(x)

TO (new)

E25 Human-Made Feature

Subclass of: E24 Physical Human-Made Thing
E26 Physical Feature

Scope Note: This class comprises physical features that are purposely created by human activity, such as scratches, artificial caves, artificial water channels, etc. In particular, it includes the information encoding features on mechanical or digital carriers.

No assumptions are made as to the extent of modification required to justify regarding a feature as human-made. For example, rock art or even "cup and ring" carvings on bedrock are regarded as types of E25 Human-Made Feature.

Examples:

- the Manchester Ship Canal (Famie, 1980)
- Michael Jackson's nose following plastic surgery
- The laser-readable "pits" engraved June 2014 on Martin Doerr's CD-R, copying songs of Edith Piaf's.
- The carved letters on the Rosetta Stone

In First Order Logic:

E25(x) ⊃ E24(x)
E25(x) ⊃ E26(x)

E27 Site

DECISION: The sig decided not to edit the scope note. It is left as is.

E31 Document

DECISION: The sig accepted the changes proposed by CEO. The scope note changed

FROM (old)

E31 Document
Subclass of: E73 Information Object
Superclass of: E32 Authority Document

Scope note: This class comprises identifiable immaterial items that make propositions about reality.

These propositions may be expressed in text, graphics, images, audiograms, videograms or by other similar means. Documentation databases are regarded as a special case of E31 Document. This class should not be confused with the term concept "document" in Information Technology, which is compatible with E73 Information Object.

Examples:

- the Encyclopaedia Britannica (E32) (Kogan, 1958)
- The image content of the photo of the Allied Leaders at Yalta published by UPI, 1945 (E36)
- the Doomsday Book

In First Order Logic:

$E31(x) \supset E73(x)$

Properties:

P70 documents (is documented in): E1 CRM Entity

TO (new)

E31 Document

Subclass of: E73 Information Object

Superclass of: E32 Authority Document

Scope note: This class comprises identifiable immaterial items that make propositions about reality.

These propositions may be expressed in text, graphics, images, audiograms, videograms or by other similar means. Documentation databases are regarded as instances of E31 Document. This class should not be confused with the concept "document" in Information Technology, which is compatible with E73 Information Object.

Examples:

- the Encyclopaedia Britannica (E32) (Kogan, 1958)
- The image content of the photo of the Allied Leaders at Yalta published by UPI, 1945 (E36)
- the Doomsday Book

In First Order Logic:

$E31(x) \supset E73(x)$

Properties:

P70 documents (is documented in): E1 CRM Entity

E33 Linguistic Object

DECISION: The sig decided to review this class and harmonize it with P190 has symbolic object.

HW: MD and RS to do the rewrite, SS and CEO to assist them.

HW: PR will contribute with respect to the different levels of symbolic specificity.

The resulted HW should be included in 7.0

HW: NC to implement the new scope note's implication in RDF.

E34 Inscription

DECISION: The sig accepted the change proposed by CEO (too restrictive, if not just wrong that inscriptions are short texts). The scope note changed

FROM (old)

E34 Inscription

| Subclass of: | E33 Linguistic Object |
| | E37 Mark |

| Scope note: | This class comprises recognisable, short texts attached to instances of E24 Physical Human-Made Thing. |

The transcription of the text can be documented in a note by P3 has note: E62 String. The alphabet used can be documented by P2 has type: E55 Type. This class does not intend to describe the idiosyncratic characteristics of an individual physical embodiment of an inscription, but the underlying prototype. The physical embodiment is modelled in the CIDOC CRM as instances of E24 Physical Human-Made Thing.

The relationship of a physical copy of a book to the text it contains is modelled using E18 Physical Thing. P128 carries (is carried by): E33 Linguistic Object.

Examples:

- "keep off the grass" on a sign stuck in the lawn of the quad of Balliol College
- The text published in Corpus Inscriptionum Latinarum V 895
- Kilroy was here

In First Order Logic:

$E34(x) \supset E33(x)$
$E34(x) \supset E37(x)$

TO (new)

E34 Inscription

| Subclass of: | E33 Linguistic Object |
| | E37 Mark |

| Scope note: | This class comprises recognisable, texts attached to instances of E24 Physical Human-Made Thing. |

The transcription of the text can be documented in a note by P3 has note: E62 String. The alphabet used can be documented by P2 has type: E55 Type. This class does not intend to describe the idiosyncratic characteristics of an individual physical embodiment of an inscription, but the underlying prototype. The physical embodiment is modelled in the CIDOC CRM as instances of E24 Physical Human-Made Thing.

The relationship of a physical copy of a book to the text it contains is modelled using E18 Physical Thing. P128 carries (is carried by): E33 Linguistic Object.

Examples:

- "keep off the grass" on a sign stuck in the lawn of the quad of Balliol College
- The text published in Corpus Inscriptionum Latinarum V 895
- Kilroy was here

In First Order Logic:

$E34(x) \supset E33(x)$
$E34(x) \supset E37(x)$

E36 Visual Item

DECISION: The sig accepted the rephrasing proposed by CEO . The scope note changed

FROM (old)

E36 Visual Item
Subclass of: E73 Information Object

Superclass of: E37 Mark

Scope Note: This class comprises the intellectual or conceptual aspects of recognisable marks and images.

This class does not intend to describe the idiosyncratic characteristics of an individual physical embodiment of a visual item, but the underlying prototype. For example, a mark such as the ICOM logo is generally considered to be the same logo when used on any number of publications. The size, orientation and colour may change, but the logo remains uniquely identifiable. The same is true of images that are reproduced many times. This means that visual items are independent of their physical support.

The class E36 Visual Item provides a means of identifying and linking together instances of E24 Physical Human-Made Thing that carry the same visual symbols, marks or images etc. The property *P62 depicts (is depicted by)* between E24 Physical Human-Made Thing and depicted subjects (E1 CRM Entity) can be regarded as a short cut of the more fully developed path from E24 Physical Human-Made Thing through *P65 shows visual item (is shown by)*, E36 Visual Item, *P138 represents (has representation)* to E1CRM Entity, which in addition captures the optical features of the depiction.

Examples:
- the visual appearance of Monet's "La Pie"
- the Coca-Cola logo (E34)
- the Chi-Rho (E37)
- the communist red star (E37)

In First Order Logic:
E36(x) ⊃ E73(x)

Properties:
P138 represents (has representation): E1 CRM Entity
    (P138.1 mode of representation: E55 Type)

TO (new)

E36 Visual Item
Subclass of: E73 Information Object
Superclass of: E37 Mark

Scope Note: This class comprises the intellectual or conceptual aspects of recognisable marks and images.

This class does not intend to describe the idiosyncratic characteristics of an individual physical embodiment of a visual item, but the underlying prototype. For example, a mark such as the ICOM logo is generally considered to be the same logo when used on any number of publications. The size, orientation and colour may change, but the logo remains uniquely identifiable. The same is true of images that are reproduced many times. This means that visual items are independent of their physical support.

The class E36 Visual Item provides a means of identifying and linking together instances of E24 Physical Human-Made Thing that carry the same visual symbols, marks or images etc. The property *P62 depicts (is depicted by)* between E24 Physical Human-Made Thing and depicted subjects (E1 CRM Entity) is a shortcut of the more fully developed path from E24 Physical Human-Made Thing through *P65 shows visual item (is shown by)*, E36 Visual Item, *P138 represents (has representation)* to E1CRM Entity, which in addition captures the optical features of the depiction.

Examples:
- the visual appearance of Monet's "La Pie"
- the Coca-Cola logo (E34)
- the Chi-Rho (E37)

- the communist red star (E37)

In First Order Logic:
$$E36(x) \supset E73(x)$$

Properties:

P138 represents (has representation): E1 CRM Entity
(P138.1 mode of representation: E55 Type)

E53 Place
DECISION: The sig accepted the editorial change proposed by CEO. The scope note changed

FROM (old)
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 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 instance of E18 Physical Thing can serve as a frame of reference for an instance of E53 Place. This may be documented using the property *P157 is at rest relative to (provides reference space for)*.

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:

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

P171 at some place within : E94 Space Primitive

P172 contains : E94 Space Primitive

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, but may also be determined by reference to mobile objects. A Place can be determined by combining a frame of reference and a location with respect to this frame.

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.

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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:

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
P171 at some place within : E94 Space Primitive
P172 contains : E94 Space Primitive

E55 Type

DECISION: There is a missing property (CEO's comment mentions that it should include an extra property, discussed in issue 401). However, the reference to the issue has a typo.

HW: CEO is to find the right issue, and add the property to the set of properties connecting FROM E55 Type TO some class.

E58 Measurement Unit

DECISION: The sig accepted the editorial change proposed by CEO. The scope note changed

E58 Measurement Unit

Subclass of: E55 Type

Superclass of: E98 Currency

Scope Note: This class is a specialization of E55 Type and comprises the types of measurement units: feet, inches, centimetres, litres, lumens, etc.

This type is used categorically in the model without reference to instances of it, i.e. the Model does not foresee the description of instances of instances of E58 Measurement Unit, e.g.: "instances of cm".

Système International (SI) units or internationally recognized non-SI terms should be used whenever possible. (ISO80000:2009). Archaic Measurement Units used in historical records should be preserved.

Examples:

- cm [centimetre]
- km [kilometre]
- m [meter]
- m/s [meters per second] (Hau, 1999)
- A [Ampere]
- GRD [Greek Drachme] (Daniel, 2014) (E98)
- °C [degrees centigrade] (Beckman, 1998)

In First Order Logic:

$$E58(x) \supset E55(x)$$

E58 Measurement Unit

Subclass of: E55 Type

Superclass of: E98 Currency

Scope Note: This class is a specialization of E55 Type and comprises the types of measurement units: feet, inches, centimetres, litres, lumens, etc.

This type is used categorically in the model without reference to instances of it, i.e. the Model does not foresee the description of instances of instances of E58 Measurement Unit, e.g.: "instances of cm".

Système International (SI) units or internationally recognized non-SI terms should be used whenever possible, such as those defined by ISO80000:2009. Archaic Measurement Units used in historical records should be preserved.

Examples:

- cm [centimetre]
- km [kilometre]
- m [meter]
- m/s [meters per second] (Hau, 1999)
- A [Ampere]
- GRD [Greek Drachme] (Daniel, 2014) (E98)
- °C [degrees centigrade] (Beckman, 1998)

In First Order Logic:

$$E58(x) \supset E55(x)$$

E62 String

DECISION: The sig decided not to implement any changes. The definition of E62 String is to remain as is.

E68 Dissolution

DECISION: The sig accepted the change proposed by CEO. The scope note changed

FROM (old)
E68 Dissolution

Subclass of: E64 End of Existence

Scope note: This class comprises the events that result in the formal or informal termination of an instance of E74 Group of people.

        If the dissolution was deliberate, the Dissolution event should also be instantiated as an instance of E7 Activity.

Examples:

- the fall of the Roman Empire (Whittington, 1964)
- the liquidation of Enron Corporation (Atlas, 2001)

In First Order Logic:

$$E68(x) \supset E64(x)$$

Properties:

P99 dissolved (was dissolved by): E74 Group

TO (new)
E68 Dissolution

Subclass of: E64 End of Existence

Scope note: This class comprises the events that result in the formal or informal termination of an instance of E74 Group.

        If the dissolution was deliberate, the Dissolution event should also be instantiated as an instance of E7 Activity.

Examples:

- the fall of the Roman Empire (Whittington, 1964)
- the liquidation of Enron Corporation (Atlas, 2001)

In First Order Logic:

$$E68(x) \supset E64(x)$$

Properties:

P99 dissolved (was dissolved by): E74 Group

E89 Propositional Object.

DECISION: The sig accepted CEO's proposal to add the reference to their existence irrespective of a physical carrier (inherited from E28 Conceptual Object, no need to be repeated in the scope note of its subclasses) –i.e. the sentence "An instance of E89 Propositional Object does not depend on a specific physical carrier, which can include human memory, and it can exist on one or more carriers simultaneously". The scope note for E89 Propositional Object did not change.

DECISION: The sig accepted CEO's proposal to add a reference to the property P190 has symbolic content and to delete the reference to their existence irrespective of a physical carrier (inherited from E28 Conceptual Object, no need to be repeated in the scope note of its subclasses) –i.e. the sentence "An instance of E89 Propositional Object does not depend on a specific physical carrier, which can include human memory, and it can exist on one or more carriers simultaneously". The scope note for E90 Symbolic Object changed

FROM (old)

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 E89 Propositional 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.

In some cases, the content of an instance of E90 Symbolic Object may completely be represented by a serialized digital content model, such as a sequence of ASCII-encoded characters, an XML or HTML document, or a TIFF image. The property *P3 has note* allows for the description of this content model. In order to disambiguate which symbolic level is the carrier of the meaning, the property *P3.1 has type* can be used to specify the encoding (e.g. "bit", "Latin character", RGB pixel).

Examples:
- 'ecognizabl'
- The "no-smoking" sign (E36)
- "BM000038850.JPG" (E41)
- image BM000038850.JPG from the Clayton Herbarium in London (E36)
- The distribution of form, tone and colour found on Leonardo da Vinci's painting named "Mona Lisa" in daylight (E36)
- The Italian text of Dante's "Divina Commedia" as found in the authoritative critical edition *La Commedia secondo l'antica vulgata a cura di Giorgio Petrocchi*, Milano: Mondadori, 1966-67 (= Le Opere di Dante Alighieri, Edizione Nazionale a cura della Società Dantesca Italiana, VII, 1-4)   (E33)

In First Order Logic:

E90(x) ⊃ E28(x)

E90(x) ⊃ E72(x)

Properties:

P106 is composed of (forms part of): E90 Symbolic Object

P190 has symbolic content: E62 String

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 may or may not have a specific meaning, for example an arbitrary character string.

In some cases, the content of an instance of E90 Symbolic Object may completely be represented by a serialized digital content model, such as a sequence of ASCII-encoded characters, an XML or HTML document, or a TIFF image. The property *P3 has note* and its subproperty *P190 has symbolic content* allow for the description of this content model. In order to disambiguate which symbolic level is the carrier of the meaning, the property *P3.1 has type* can be used to specify the encoding (e.g. "bit", "Latin character", RGB pixel).

Examples:

- 'ecognizabl'
- The "no-smoking" sign (E36)
- "BM000038850.JPG" (E41)
- image BM000038850.JPG from the Clayton Herbarium in London (E36)
- The distribution of form, tone and colour found on Leonardo da Vinci's painting named "Mona Lisa" in daylight (E36)
- The Italian text of Dante's "Divina Commedia" as found in the authoritative critical edition *La Commedia secondo l'antica vulgata a cura di Giorgio Petrocchi*, Milano: Mondadori, 1966-67 (= Le Opere di Dante Alighieri, Edizione Nazionale a cura della Società Dantesca Italiana, VII, 1-4)   (E33)

In First Order Logic:

$$E90(x) \supset E28(x)$$
$$E90(x) \supset E72(x)$$

Properties:

P106 is composed of (forms part of): E90 Symbolic Object

P190 has symbolic content: E62 String

2. *Properties*

P1 is identified by

DECISION: The sig accepted the edit by CEO (deletion of the wrong part of the shortcut). The scope note for P1 is identified by changed

P1 is identified by (identifies)

Domain:	E1 CRM Entity
Range:	E41 Appellation
Superproperty of:	E1 CRM Entity. P48 has preferred identifier (is preferred identifier of): E42 Identifier
	E71 Human-Made Thing. P102 has title (is title of): E35 Title
Quantification:	many to many (0,n:0,n)

Scope note: This property describes the naming or identification of any real world item by a name or any other identifier.

This property is intended for identifiers in general use, which form part of the world the model intends to describe, and not merely for internal database identifiers which are specific to a technical system, unless these latter also have a more general use outside the technical context. This property includes in particular identification by mathematical expressions such as coordinate systems used for the identification of instances of E53 Place. The property does not reveal anything about when, where and by whom this identifier was used. A more detailed representation can be made using the fully developed (i.e. indirect) path through E15 Identifier Assignment.

P1 is identified by (identifies), is a shortcut for the path from 'E1 CRM Entity' through 'P140i was attributed by', 'E15 Identifier Assignment', 'P37 assigned', 'E42 Identifier', 'P139 has alternative form' to 'E41 Appellation'.

Examples:

the capital of Italy (E53) is identified by "Rome" (E41)
text 25014–32 (E33) is identified by "The Decline and Fall of the Roman Empire" (E35)

In First Order Logic:

P1(x,y) ⊃ E1(x)
P1(x,y) ⊃ E41(y)

TO (new)

P1 is identified by (identifies)

Domain: E1 CRM Entity
Range: E41 Appellation
Superproperty of: E1 CRM Entity. P48 has preferred identifier (is preferred identifier of): E42 Identifier
E71 Human-Made Thing. P102 has title (is title of): E35 Title
Quantification: many to many (0,n:0,n)

Scope note: This property describes the naming or identification of any real world item by a name or any other identifier.

This property is intended for identifiers in general use, which form part of the world the model intends to describe, and not merely for internal database identifiers which are specific to a technical system, unless these latter also have a more general use outside the technical context. This property includes in particular identification by mathematical expressions such as coordinate systems used for the identification of instances of E53 Place. The property does not reveal anything about when, where and by whom this identifier was used. A more detailed representation can be made using the fully developed (i.e. indirect) path through E15 Identifier Assignment.

P1 is identified by (identifies), is a shortcut for the path from 'E1 CRM Entity' through 'P140i was attributed by', 'E15 Identifier Assignment', 'P37 assigned', 'E42 Identifier'.

Examples:

the capital of Italy (E53) is identified by "Rome" (E41)
text 25014–32 (E33) is identified by "The Decline and Fall of the Roman Empire" (E35)

In First Order Logic:

P1(x,y) ⊃ E1(x)
P1(x,y) ⊃ E41(y)

P2 has type

DECISION: The scope note is to be kept as is. The yellow highlight seems random and is to be removed.

P50 has current keeper

DECISION: The sig accepted the edit by CEO. The scope note forP50 has current keeper changed

FROM (old)

P50 has current keeper (is current keeper of)

Domain:	E18 Physical Thing
Range:	E39 Actor
Subproperty of:	E18 Physical Thing. P49 has former or current keeper (is former or current keeper of): E39 Actor
Quantification:	many to many (0,n:0,n)

Scope note: This property identifies the E39 Actor or Actors who had custody of an instance of E18 Physical Thing at the time of validity of the record or database containing the statement that uses this property.

P50 has current keeper (is current keeper of) is a shortcut for the more detailed path from 'E18 Physical Thing' through, 'P30i custody transferred through', 'E10 Transfer of Custody', 'P29 custody received by', to 'E39 Actor'.

Examples:

- paintings from The Iveagh Bequest (E18) has current keeper The National Gallery (E74)

In First Order Logic:

P50(x,y) ⊃ E18(x)
P50(x,y) ⊃ E39(y)
P50(x,y) ⊃ P49(x,y)

TO (new)

P50 has current keeper (is current keeper of)

Domain:	E18 Physical Thing
Range:	E39 Actor
Subproperty of:	E18 Physical Thing. P49 has former or current keeper (is former or current keeper of): E39 Actor
Quantification:	many to many (0,n:0,n)

Scope note: This property identifies an instance E39 Actor that had custody of an instance of E18 Physical Thing at the time of validity of the record or database containing the statement that uses this property.

P50 has current keeper (is current keeper of) is a shortcut for the more detailed path from 'E18 Physical Thing' through, 'P30i custody transferred through', 'E10 Transfer of Custody', 'P29 custody received by', to 'E39 Actor'.

Examples:

- paintings from The Iveagh Bequest (E18) has current keeper The National Gallery (E74)

In First Order Logic:

P50(x,y) ⊃ E18(x)
P50(x,y) ⊃ E39(y)
P50(x,y) ⊃ P49(x,y)

P51 has former or current owner

DECISION: The sig accepted the edits by CEO. The scope note for P51 has former or current owner changed

P51 has former or current owner (is former or current owner of)

Domain:	E18 Physical Thing
Range:	E39 Actor

Superproperty of: E18 Physical Thing. P52 has current owner (is current owner of): E39 Actor

Quantification: many to many (0,n:0,n)

Scope note: This property identifies the E39 Actor that is or has been the legal owner (i.e. title holder) of an instance of E18 Physical Thing at some time.

The distinction with *P52 has current owner (is current owner of)* is that *P51 has former or current owner (is former or current owner of)* does not indicate whether the specified owners are current. *P51 has former or current owner (is former or current owner of)* is a shortcut for the more detailed path from '*E18 Physical Thing*' through '*P24i changed ownership through*', '*E8 Acquisition*', '*P23 transferred title from*', or '*P22 transferred title to*', to '*E39 Actor.*'

Examples:

- paintings from the Iveagh Bequest (E18) *has former or current owner* Lord Iveagh (E21)

In First Order Logic:

$$P51(x,y) \supset E18(x)$$
$$P51(x,y) \supset E39(y)$$

TO (new)

P51 has former or current owner (is former or current owner of)

Domain:	E18 Physical Thing
Range:	E39 Actor

Superproperty of: E18 Physical Thing. P52 has current owner (is current owner of): E39 Actor

Quantification: many to many (0,n:0,n)

Scope note: This property identifies an instance E39 Actor that is or had been the legal owner (i.e. title holder) of an instance of E18 Physical Thing at some time.

The distinction with *P52 has current owner (is current owner of)* is that *P51 has former or current owner (is former or current owner of)* does not indicate whether the specified owners are current. *P51 has former or current owner (is former or current owner of)* is a shortcut for the more detailed path from '*E18 Physical Thing*' through '*P24i changed ownership through*', '*E8 Acquisition*', '*P23 transferred title from*', or '*P22 transferred title to*', to '*E39 Actor*.'

Examples:

- paintings from the Iveagh Bequest (E18) *has former or current owner* Lord Iveagh (E21)

In First Order Logic:

$$P51(x,y) \supset E18(x)$$
$$P51(x,y) \supset E39(y)$$

P53 has former or current location

DECISION: The sig accepted the edit by CEO. The scope note for P53 has former or current location changed

FROM (old)

P53 has former or current location (is former or current location of)

Domain:	E18 Physical Thing

Range: E53 Place
Superproperty of: E19 Physical Object. P55 has current location (currently holds): E53 Place
Quantification: many to many, necessary (1,n:0,n)

Scope note: This property associates   an instance of E53 Place as the former or current location of an instance of E18 Physical Thing.

In the case of E19 Physical Objects, the property does not allow any indication of the Time-Span during which the E19 Physical Object was located at this Place, nor if this is the current location.

In the case of immobile objects, the Place would normally correspond to the Place of creation.

P53 has former or current location (is former or current location of) is a shortcut. A more detailed representation can make use of the fully developed (i.e. indirect) path from 'E19 Physical Object', though, 'P25i moved by', 'E9 Move', 'P26 moved to' or 'P27 moved from', to ' E53 Place'.

Examples:
- silver cup 232 (E22) has former or current location Display Case 4, Room 23, Museum of Oxford (E53)

In First Order Logic:
P53(x,y) ⊃ E18(x)
P53(x,y) ⊃ E53(y)

TO (new)

P53 has former or current location (is former or current location of)
Domain: E18 Physical Thing
Range: E53 Place
Superproperty of: E19 Physical Object. P55 has current location (currently holds): E53 Place
Quantification: many to many, necessary (1,n:0,n)

Scope note: This property identifies an instance of E53 Place as the former or current location of an instance of E18 Physical Thing.

In the case of instances of E19 Physical Object, the property does not allow any indication of the Time-Span during which the instance of E19 Physical Object was located at this instance of E53 Place, nor if this is the current location.

In the case of immobile objects, the Place would normally correspond to the Place of creation.

P53 has former or current location (is former or current location of) is a shortcut. A more detailed representation can make use of the fully developed (i.e. indirect) path from 'E19 Physical Object', though, 'P25i moved by', 'E9 Move', 'P26 moved to' or 'P27 moved from', to ' E53 Place'.

Examples:
- silver cup 232 (E22) has former or current location Display Case 4, Room 23, Museum of Oxford (E53)

In First Order Logic:
P53(x,y) ⊃ E18(x)
P53(x,y) ⊃ E53(y)

P54 has current permanent location

DECISION: P54 has current permanent location is to be kept as is for v.7.0. The issue 455 will remain open. MD has an issue to try to deprecate it by proving it is useless.

P59 has section

DECISION: The extra text regarding the sig meeting and issue 397 was deleted from the scope note. It should have never been there. The scope note for P59 has section is:

P59 has section (is located on or within)

Domain: E18 Physical Thing
Range: E53 Place
Quantification: one to many (0,n:0,1)

Scope note: This property links an area, i.e., an instance of E53 Place to the instance of E18 Physical Thing upon which it is found. This area may either be identified by a name, or by a geometry in terms of a coordinate system adapted to the shape of the respective instance of E18 Physical Thing. Typically, names identifying sections of physical objects are composed of the name of a kind of part and the name of the object itself, such as "The poop deck of H.M.S. Victory", which is composed of "poop deck" and "H.M.S. Victory".

Examples:
- HMS Victory (E22) has section HMS Victory section B347.6 (E53)

In First Order Logic:
$$P59(x,y) \supset E18(x)$$
$$P59(x,y) \supset E53(y)$$

P71 lists

DECISION: the sig edited the scope note for P71 lists. The scope note for P71 lists changed

FROM (old)

P71 lists (is listed in)

Domain: E32 Authority Document
Range: E1 CRM Entity
Subproperty of: 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 a source E32 Authority Document for an instance of an E1 CRM Entity.

Examples:
- the Art & Architecture Thesaurus (E32) lists alcazars (E55)

In First Order Logic:
$$P71(x,y) \supset E32(x)$$
$$P71(x,y) \supset E1(y)$$
$$P71(x,y) \supset P67(x,y)$$

TO (new)

P71 lists (is listed in)

Domain: E32 Authority Document
Range: E1 CRM Entity
Subproperty of: 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 associates an instance of E32 Authority Document with an instance of E1 CRM entity which it lists for reference purposes.

Examples:

- the Art & Architecture Thesaurus (E32) lists alcazars (E55)

In First Order Logic:

P71(x,y) ⊃ E32(x)
P71(x,y) ⊃ E1(y)
P71(x,y) ⊃ P67(x,y)

P72 has language

DECISION: The sig edited the scope note for P72 has language, taking CEO's suggestions into account. The scope note for P72 has language changed

FROM (old)

P72 has language (is language of)

Domain: E33 Linguistic Object
Range: E56 Language
Quantification: many to many, necessary (1,n:0,n)

Scope note: This property describes the instance(s) of E56 Language of an instance of E33 Linguistic Object.

Linguistic Objects are composed in one or more human Languages. This property allows these languages to be documented.

Examples:

- the American Declaration of Independence (E33) has language 18th Century English (E56)

In First Order Logic:

P72(x,y) ⊃ E33(x)
P72(x,y) ⊃ E56(y

TO (new)

P72 has language (is language of)

Domain: E33 Linguistic Object
Range: E56 Language
Quantification: many to many, necessary (1,n:0,n)

Scope note: This property associates an instance of E33 Linguistic Object with an instance of E56 Language, in which it is at least partially expressed.

Linguistic Objects are composed in one or more human Languages. This property allows these languages to be documented.

Examples:

- the American Declaration of Independence (E33) has language 18th Century English (E56)

In First Order Logic:

P72(x,y) ⊃ E33(x)
P72(x,y) ⊃ E56(y

P73 has translation

DECISION: The sig reformulated the scope note according to CEO's suggestions. The scope note for P73 has translation changed

FROM (old)

P73 has translation (is translation of)

Domain: E33 Linguistic Object

Range: E33 Linguistic Object
Subproperty of: E70 Thing. P130i features are also found on: E70 Thing
Quantification: one to many (0,n:0,1)

Scope note: This property describes the source and target of instances of E33Linguistic Object involved in a translation.

                  When a Linguistic Object is translated into a new language it becomes a new Linguistic Object, despite being conceptually similar to the source object.

                  This property is transitive

Examples:

    ▪   "Les Baigneurs" (E33) has translation "The Bathers" (E33)
In First Order Logic:

        P73(x,y) ⊃ E33(x)
        P73(x,y) ⊃ E33(y)
        P73(x,y) ⊃ P130(y,x)

TO (new)

P73 has translation (is translation of)
Domain: E33 Linguistic Object
Range: E33 Linguistic Object
Subproperty of: E70 Thing. P130i features are also found on: E70 Thing
Quantification: one to many (0,n:0,1)

Scope note: This property links an instance of a E33 Linguistic Objet (A) to another instance of E33 Linguistic Object (B) which is the translation of A.

                  When an instance of E33 Linguistic Object is translated into a new language a new instance of E33 Linguistic Object is created, despite the translation being conceptually similar to the source object.

                  This property is transitive.

Examples:

    ▪   "Les Baigneurs" (E33) has translation "The Bathers" (E33)
In First Order Logic:

        P73(x,y) ⊃ E33(x)
        P73(x,y) ⊃ E33(y)
        P73(x,y) ⊃ P130(y,x)

P75 possesses

DECISION: The sig reformulated the scope note according to CEO's suggestions. The scope note for P75 possessed changed

FROM (old)

P75 possesses (is possessed by)
Domain: E39 Actor
Range: E30 Right
Quantification: many to many (0,n:0,n)

Scope note: This property identifies former or current instances of E30 Rights held by an E39 Actor.

Examples:

    ▪   Michael Jackson (E21) possesses Intellectual property rights on the Beatles' back catalogue (E30).

In First Order Logic:

        P75(x,y) ⊃ E39(x)

        P75(x,y) ⊃ E30(y)

TO (new)

P75 possesses (is possessed by)

Domain: E39 Actor

Range: E30 Right

Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E39 Actor to an instance of E30 Right over which the actor holds or has held a legal claim.

Examples:

- Michael Jackson (E21) possesses Intellectual property rights on the Beatles' back catalogue (E30).

In First Order Logic:

        P75(x,y) ⊃ E39(x)

        P75(x,y) ⊃ E30(y)

P76 has contact point

DECISION: The sig reformulated the scope note according to CEO's suggestions. The scope note for P76 has contact point changed

FROM (old)

P76 has contact point (provides access to)

Domain: E39 Actor

Range: E41 Appellation

Quantification: many to many (0,n:0,n)

Scope note: This property identifies an instance of E51 Contact Point of any type that provides access to an instance of E39 Actor by any communication method, such as e-mail or fax.

Examples:

- RLG (E40) has contact point "bl.ric@rlg.org" (E41)

In First Order Logic:

        P76(x,y) ⊃ E39(x)

        P76(x,y) ⊃ E41(y)

TO (new)

P76 has contact point (provides access to)

Domain: E39 Actor

Range: E41 Appellation

Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E39 Actor to an instance of E41 Appellation, which a communication service uses to direct communications to this actor, such as e-mail address, fax number or postal address.

Examples:

- RLG (E40) has contact point "bl.ric@rlg.org" (E41)

In First Order Logic:

        P76(x,y) ⊃ E39(x)

        P76(x,y) ⊃ E41(y)

P86 falls within (contains)

DECISION: The sig edited the scope note according to CEO's suggestions. The scope note for P86 has formed changed

FROM (old)

Domain: E52 Time-Span

Range: E52 Time-Span
Quantification: many to many (0,n:0,n)

Scope note: This property describes the inclusion relationship between two instances of E52
Time-Span.

This property supports the notion that a Time-Span's temporal extent falls within the temporal extent of another Time-Span. It addresses temporal containment only, and no contextual link between the two instances of Time-Span is implied.

This property is transitive.

Examples:

- the time-span of the Apollo 11 moon mission (E52) *falls within* the time-span of the reign of Queen Elizabeth II (E52)

In First Order Logic:

P86(x,y) ⊃ E52(x)

P86(x,y) ⊃ E52(y)

TO (new)

Domain: E52 Time-Span

Range: E52 Time-Span
Quantification: many to many (0,n:0,n)

Scope note: This property describes the inclusion relationship between two instances of E52
Time-Span.

This property supports the notion that the temporal extent of an instance of E52 Time-Span falls within the temporal extent of another instance of E52 Time-Span. It addresses temporal containment only, and no contextual link between the two instances of E52 Time-Span is implied.

This property is transitive.

Examples:

- the time-span of the Apollo 11 moon mission (E52) *falls within* the time-span of the reign of Queen Elizabeth II (E52)

In First Order Logic:

$$P86(x,y) \supset E52(x)$$

$$P86(x,y) \supset E52(y)$$

P95 has formed

DECISION: The sig edited the scope note according to CEO's suggestions. The scope note for P95 has formed changed

FROM (old)

P95 has formed (was formed by)

Domain:	E66 Formation
Range:	E74 Group
Subproperty of:	E63 Beginning of Existence. P92 brought into existence (was brought into existence by): E77 Persistent Item
Quantification:	one to many, necessary, dependent (1,n:1,1)

Scope note: This property links the founding or E66 Formation for an E74 Group with the Group itself.

Examples:

- the formation of the CIDOC CRM SIG at the August 2000 CIDOC Board meeting (E66) has formed the CIDOC CRM Special Interest Group (E74)

In First Order Logic:

$$P95(x,y) \supset E66(x)$$
$$P95(x,y) \supset E74(y)$$
$$P95(x,y) \supset P92(x,y)$$

TO (new)

P95 has formed (was formed by)

Domain:	E66 Formation
Range:	E74 Group
Subproperty of:	E63 Beginning of Existence. P92 brought into existence (was brought into existence by): E77 Persistent Item
Quantification:	one to many, necessary, dependent (1,n:1,1)

Scope note: This property associates the instance of E66 Formation with the instance of Group that it founded.

Examples:

- the formation of the CIDOC CRM SIG at the August 2000 CIDOC Board meeting (E66) has formed the CIDOC CRM Special Interest Group (E74)

In First Order Logic:

$$P95(x,y) \supset E66(x)$$
$$P95(x,y) \supset E74(y)$$
$$P95(x,y) \supset P92(x,y)$$

P99 dissolved

DECISION: The sig edited the scope note according to CEO's suggestions. The scope note for P99 dissolved changed

FROM (old)

P99 dissolved (was dissolved by)

Domain:	E68 Dissolution
Range:	E74 Group
Subproperty of:	E5 Event. P11 had participant (participated in): E39 Actor
	E64 End of Existence. P93 took out of existence (was taken out of existence by): E77 Persistent Item

Quantification: one to many, necessary (1,n:0,n)

Scope note: This property links the disbanding or E68 Dissolution of an E74 Group to the Group itself.

Examples:

- the end of The Hole in the Wall Gang (E68) dissolved The Hole in the Wall Gang (E74)

In First Order Logic:

P99(x,y) ⊃ E68(x)
P99(x,y) ⊃ E74(y)
P99(x,y) ⊃ P11(x,y)
P99(x,y) ⊃ P93(x,y)

TO (new)

P99 dissolved (was dissolved by)
Domain: E68 Dissolution
Range: E74 Group
Subproperty of: E5 Event. P11 had participant (participated in): E39 Actor
E64 End of Existence. P93 took out of existence (was taken out of existence by): E77 Persistent Item
Quantification: one to many, necessary (1,n:0,n)

Scope note: This property associates the instance of E68 Dissolution with the instance of an E74 Group that it disbanded.

Examples:

- the end of The Hole in the Wall Gang (E68) dissolved The Hole in the Wall Gang (E74)

In First Order Logic:

P99(x,y) ⊃ E68(x)
P99(x,y) ⊃ E74(y)
P99(x,y) ⊃ P11(x,y)
P99(x,y) ⊃ P93(x,y)

P101 had as general use

DECISION: The sig edited the scope note according to CEO's suggestions. However, the scope note needs be tuned to any decision concerning the use of the terms *general vs. specific* and the scope note of P101 see [NEW ISSUE] above. The scope note for P101 had as general use changed

FROM (old)

P101 had as general use (was use of)
Domain: E70 Thing
Range: E55 Type
Quantification: many to many (0,n:0,n)

Scope note: This property links an instance of E70 Thing to an E55 Type of usage.

It allows the relationship between particular things, both physical and immaterial, and general methods and techniques of use to be documented. Thus it can be asserted that a baseball bat had a general use for sport and a specific use for threatening people during the Great Train Robbery.

Examples:

- Tony Gill's Ford Mustang (E22) had as general use transportation (E55)

In First Order Logic:

P101(x,y) ⊃ E70(x)
P101(x,y) ⊃ E55(y)

P101 had as general use (was use of)

Domain: E70 Thing
Range: E55 Type
Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E70 Thing with an instance of E55 Type describing the general usage.

It allows the relationship between particular things, both physical and immaterial, and general methods and techniques of use to be documented. Thus it can be asserted that a baseball bat had a general use for sport and a specific use for threatening people during the Great Train Robbery.

Examples:

- Tony Gill's Ford Mustang (E22) had as general use transportation (E55)

In First Order Logic:

P101(x,y) ⊃ E70(x)
P101(x,y) ⊃ E55(y)

P102 has title

Reviewing of this property initiated an open discussion regarding its usefulness. MD suggested to deprecate it, but what was decided instead was to look for a better example to confirm (or disprove) its usefulness.

DECISION: The sig edited the scope note according to CEO's suggestions and appointed MD to provide a better example [HW]. The scope note for P102 has title changed

FROM (old)

P102 has title (is title of)

Domain: E71 Human-Made Thing
Range: E35 Title
Subproperty of: E1 CRM Entity. P1 is identified by (identifies): E41 Appellation
Quantification: many to many (0,n:0,n)

Scope note: This property describes the E35 Title applied to an instance of E71 Human-Made Thing. The E55 Type of Title is assigned in a sub property.

The P102.1 has type property of the P102 has title (is title of) property enables the relationship between the Title and the thing to be further clarified, for example, if the Title was a given Title, a supplied Title etc.

It allows any human-made material or immaterial thing to be given a Title. It is possible to imagine a Title being created without a specific object in mind.

Examples:

- the first book of the Old Testament (E33) has title "Genesis" (E35)
    has type translated (E55)

In First Order Logic:

P102(x,y) ⊃ E71(x)
P102(x,y) ⊃ E35(y)
P102(x,y,z) ⊃ [P102(x,y) ∧ E55(z)]
P102(x,y) ⊃ P1(x,y)

Properties: P102.1 has type: E55 Type

P102 has title (is title of)

Domain: E71 Human-Made Thing

Range: E35 Title

Subproperty of: E1 CRM Entity. P1 is identified by (identifies): E41 Appellation

Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E35 Title that has been applied to an instance of E71 Human-Made Thing.

The P102.1 has type property of the P102 has title (is title of) property enables the relationship between the Title and the thing to be further clarified, for example, if the Title was a given title, a supplied title etc.

It allows any human-made material or immaterial thing to be given a Title. It is possible to imagine a title being created without a specific object in mind.

Examples:

- the first book of the Old Testament (E33) has title "Genesis" (E35)
      has type translated (E55)

In First Order Logic:

> P102(x,y) ⊃ E71(x)
> P102(x,y) ⊃ E35(y)
> P102(x,y,z) ⊃ [P102(x,y) ∧ E55(z)]
> P102(x,y) ⊃ P1(x,y)

Properties: P102.1 has type: E55 Type

P103 was intended for

DECISION: the scope note of P103 needs be further reviewed in the context of the new issue above on defining the meaning of the terms *general vs. specific* in the CRM universe.
HW to SS to revise.

DECISION: For version 7.0, the cope note edited by the sig according to CEO's suggestions, will do. The scope note for P103 was intended for changed

P103 was intended for (was intention of)

Domain: E71 Human-Made Thing

Range: E55 Type

Quantification: many to many (0,n:0,n)

Scope note: This property links an instance of E71 Human-Made Thing to an E55 Type of usage.

It creates a property between specific human-made things, both physical and immaterial, to types of intended methods and techniques of use. Note: A link between specific human-made things and a specific use activity should be expressed using P19 was intended use of (was made for).

Examples:

- this plate (E22) was intended for being destroyed at wedding reception (E55)

In First Order Logic:

> P103(x,y) ⊃ E71(x)
> P103(x,y) ⊃ E55(y)

P103 was intended for (was intention of)

Domain: E71 Human-Made Thing
Range: E55 Type
Quantification: many to many (0,n:0,n)

Scope note: This property links an instance of E71 Human-Made Thing to an instance of E55 Type describing its intended usage.

It creates a relation between specific human-made things, both physical and immaterial, to Types   of intended methods and techniques of use. Note: A link between specific human-made things and a specific use activity should be expressed using P19 was intended use of (was made for).

Examples:
- this plate (E22) was intended for being destroyed at wedding reception (E55)

In First Order Logic:
P103(x,y) ⊃ E71(x)
P103(x,y) ⊃ E55(y)

P107 has current or former member

DECISION: The sig edited the scope note according to CEO's suggestions. The scope note changed

FROM (old)

P107 has current or former member (is current or former member of)

Domain: E74 Group
Range: E39 Actor
Quantification: many to many (0,n:0,n)

Scope note: This property relates an E39 Actor to the E74 group of which that E39 Actor is a member.

Groups, Legal Bodies and Persons, may all be members of Groups. A Group necessarily consists of more than one member.

This property is a shortcut of the more fully developed path *E74 Group, P144i gained member by, E85 Joining, P143 joined, E39 Actor*

The property P107.1 *kind of member* can be used to specify the type of membership or the role the member has in the group.

Examples:
- Moholy Nagy (E21) *is current or former member of* Bauhaus (E74)
- National Museum of Science and Industry (E40) *has current or former member* The National Railway Museum (E40)
- The married couple Queen Elisabeth and Prince Phillip (E74) *has current or former member* Prince Phillip (E21) with P107.1 *kind of member* husband (E55 Type)

In First Order Logic:
P107(x,y) ⊃ E74(x)
P107(x,y) ⊃ E39(y)
P107(x,y,z) ⊃ [P107(x,y) ∧ E55(z)]

Properties: P107.1 kind of member: E55 Type

TO (new)

P107 has current or former member (is current or former member of)

Domain:	E74 Group
Range:	E39 Actor
Quantification:	many to many (0,n:0,n)

Scope note: This property associates an instance of E74 Group with the instance of E39 Actor that is a member thereof.

Instances of E74 Group and E21 Person may all be members of instances of E74 Groups. An instance of E74 Group may be founded initially without any member.

This property is a shortcut of the more fully developed path *E74 Group, P144i gained member by, E85 Joining, P143 joined, E39 Actor*

The property P107.1 *kind of member* can be used to specify the type of membership or the role the member has in the group.

Examples:

- Moholy Nagy (E21) *is current or former member of* Bauhaus (E74)
- National Museum of Science and Industry (E74) *has current or former member* The National Railway Museum (E74)
- The married couple Queen Elisabeth and Prince Phillip (E74) *has current or former member* Prince Phillip (E21) with P107.1 *kind of member* husband (E55 Type)

In First Order Logic:

P107(x,y) ⊃ E74(x)
P107(x,y) ⊃ E39(y)
P107(x,y,z) ⊃ [P107(x,y) ∧ E55(z)]

Properties: P107.1 kind of member: E55 Type

P121 overlaps with
DECISION: The scope note needs be updated. The property is compared to a class –which it shouldn't –and hence needs be edited. Reference must be made to properties of temporal overlap, not time primitives. Reference must also be made to P132 spatiotemporally overlaps.
HW to MD to reformulate the scope note.

P122 borders with
DECISION: The scope note needs be updated. The property is compared to a class –which it shouldn't –and hence needs be edited. Reference must be made to properties of temporal overlap, not time primitives.

HW to MD to reformulate the scope note.

P125 used object of type
DECISION: The scope note needs redrafting. SS is to provide a new scope note [**HW**]. Make sure that the order of the classes appears in the forward rather than the inverse order (as are now).

P137 exemplifies
DECISION: The sig edited the scope note according to CEO's suggestions. The scope note for P137 exemplifies changed

FROM (old)
P137 exemplifies (is exemplified by)
Domain: E1 CRM Entity

Range:	E55 Type
Subproperty of:	E1 CRM Entity. P2 has type (is type of):E55 Type
Quantification:	many to many (0,n:0,n)

Scope note: This property allows an item to be declared as a particular example of an E55 Type or taxon)

The *P137.1 in the taxonomic role* property of *P137 exemplifies (is exemplified by)* allows differentiation of taxonomic roles. The taxonomic role renders the specific relationship of this example to the Type, such as "prototypical", "archetypical", "lectotype", etc. The taxonomic role "lectotype" is not associated with the Type Creation itself (E83), but selected in a later phase.

Examples:

- Object BM000098044 of the Clayton Herbarium (E20) *exemplifies* Spigelia marilandica (L.) L. (E55) in the taxonomic role lectotype

In First Order Logic:

P137(x,y) ⊃ E1(x)
P137(x,y) ⊃ E55(y)
P137(x,y,z) ⊃ [P137(x,y) ∧ E55(z)]
P137(x,y) ⊃ P2(x,y)

Properties: P137.1 in the taxonomic role: E55 Type

TO (new)
P137 exemplifies (is exemplified by)

Domain:	E1 CRM Entity
Range:	E55 Type
Subproperty of:	E1 CRM Entity. P2 has type (is type of):E55 Type
Quantification:	many to many (0,n:0,n)

Scope note: This property associates an instance of E1 CRM Entity with an instance of E55 Type, for which it has been declared to be a particularly characteristic example.

The *P137.1 in the taxonomic role* property of *P137 exemplifies (is exemplified by)* allows differentiation of taxonomic roles. The taxonomic role renders the specific relationship of this example to the type, such as "prototypical", "archetypical", "lectotype", etc. The taxonomic role "lectotype" is not associated with the instance of E83 Type Creation itself, but selected in a later phase.

Examples:

- Object BM000098044 of the Clayton Herbarium (E20) *exemplifies* Spigelia marilandica (L.) L. (E55) in the taxonomic role lectotype

In First Order Logic:

P137(x,y) ⊃ E1(x)
P137(x,y) ⊃ E55(y)
P137(x,y,z) ⊃ [P137(x,y) ∧ E55(z)]
P137(x,y) ⊃ P2(x,y)

Properties: P137.1 in the taxonomic role: E55 Type

P140 assigned attribute to
DECISION: The sig edited the scope note according to CEOs proposal. The scope note for P140 assigned attribute to changed

FROM (old)
P140 assigned attribute to (was attributed by)

Domain: E13 Attribute Assignment
Range: E1 CRM Entity
Superproperty of: E14 Condition Assessment. P34 concerned (was assessed by): E18 Physical Thing
                 E16 Measurement. P39 measured (was measured by): E70 Thing
                 E17 Type Assignment. P41 classified (was classified by): E1 CRM Entity
Quantification: many to many (0,n:0,n)

Scope note: This property indicates the item to which an attribute or relation is assigned.

Examples:

- February 1997 Current Ownership Assessment of Martin Doerr's silver cup (E13) assigned attribute to Martin Doerr's silver cup (E19)
- 01 June 1997 Identifier Assignment of the silver cup donated by Martin Doerr (E15) assigned attribute to silver cup 232 (E19)

In First Order Logic:
                 P140(x,y) ⊃ E13(x)
                 P140(x,y) ⊃ E1(y)

TO (new)

P140 assigned attribute to (was attributed by)
Domain: E13 Attribute Assignment
Range: E1 CRM Entity
Superproperty of: E14 Condition Assessment. P34 concerned (was assessed by): E18 Physical Thing
                 E16 Measurement. P39 measured (was measured by): E70 Thing
                 E17 Type Assignment. P41 classified (was classified by): E1 CRM Entity
Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E13 Attribute Assignment with the instance of E1 CRM Entity about which the attribution was made. The instance of E1 CRM Entity plays the role of the domain of the attribution.

                 The kind of attribution made should be documented using P177 assigned property type.

Examples:

- February 1997 Current Ownership Assessment of Martin Doerr's silver cup (E13) *assigned attribute to* Martin Doerr's silver cup (E19)
- 01 June 1997 Identifier Assignment of the silver cup donated by Martin Doerr (E15) *assigned attribute to* silver cup 232 (E19)

In First Order Logic:
                 P140(x,y) ⊃ E13(x)
                 P140(x,y) ⊃ E1(y)

P141 assigned

DECISION: The sig edited the scope note according to CEOs proposal. The scope note for P141 assigned changed

FROM (old)
Domain: E13 Attribute Assignment
Range: E1 CRM Entity
Superproperty of: E14 Condition Assessment. P35 has identified (identified by): E3 Condition State
                 E15 Identifier Assignment. P37 assigned (was assigned by): E42 Identifier
                 E15 Identifier Assignment. P38 deassigned (was deassigned by): E42 Identifier
                 E16 Measurement. P40 observed dimension (was observed in): E54 Dimension
                 E17 Type Assignment. P42 assigned (was assigned by): E55 Type

Quantification: many to many (0,n:0,n)

Scope note: This property indicates the attribute that was assigned or the item that was related to the item denoted by a property P140 assigned attribute to in an instance of E13 Attribute Assignment.

Examples:

- February 1997 Current Ownership Assessment of Martin Doerr's silver cup (E13) *assigned* Martin Doerr (E21)
- 01 June 1997 Identifier Assignment of the silver cup donated by Martin Doerr (E15) *assigned* object identifier 232

In First Order Logic:

P141(x,y) ⊃ E13(x)
P141(x,y) ⊃ E1(y)

TO (new)

P141 assigned (was assigned by)

Domain: E13 Attribute Assignment
Range: E1 CRM Entity
Superproperty of: E14 Condition Assessment. P35 has identified (identified by): E3 Condition State
    E15 Identifier Assignment. P37 assigned (was assigned by): E42 Identifier
    E15 Identifier Assignment. P38 deassigned (was deassigned by): E42 Identifier
    E16 Measurement. P40 observed dimension (was observed in): E54 Dimension
    E17 Type Assignment. P42 assigned (was assigned by): E55 Type
Quantification: many to many (0,n:0,n)

Scope note: This property identifies the instance of E1 CRM Entity that was assigned as an attribute to another instance of E1 CRM Entity in an instance of E13 Attribute Assignment

The kind of attribution made should be documented using p177 assigned property type.

Examples:

- February 1997 Current Ownership Assessment of Martin Doerr's silver cup (E13) *assigned* Martin Doerr (E21)
- 01 June 1997 Identifier Assignment of the silver cup donated by Martin Doerr (E15) *assigned* object identifier 232

In First Order Logic:

P141(x,y) ⊃ E13(x)
P141(x,y) ⊃ E1(y)

P142 used constituent

DECISION: The sig edited the scope note according to CEOs proposal. The scope note for P142 used constituent changed

FROM (old)

P142 used constituent (was used in)

Domain: E15 Identifier Assignment
Range: E90 Symbolic Object
Subproperty of: E7 Activity. P16 used specific object (was used for): E70 Thing
Quantification: (0:n,0:n)

Scope note: This property associates the event of assigning an instance of E42 Identifier with the instances of E90 Symbolic Object that were used as constituents of the identifier.

Examples:

- On June 1, 2001 assigning the personal name identifier "Guillaume, de Machaut, ca. 1300-1377" (E15) *used constituent* "ca. 1300-1377" (E41)
- Assigning a uniform title to the anonymous textual work known as 'The Adoration of the Shepherds'(E15) *used constituent* 'Coventry' (E41)
- Assigning a uniform title to Pina Bausch's choreographic work entitled 'Rite of spring' (E15) used constituent '(Choreographic Work: Bausch)'(E90)
- Assigning a uniform title to the motion picture directed in 1933 by Merian C. Cooper and Ernest B. Schoedsack and entitled 'King Kong' (E15) *used constituent* '1933' (E41)
- Assigning the corporate name identifier 'Univerza v Ljubljani. Oddelek za bibliotekarstvo' to The Department for library science of the University of Ljubljana (E15) *used constituent* 'Univerza v Ljubljani' (E42)

In First Order Logic:

P142(x,y) ⊃ E15(x)
P142(x,y) ⊃ E90(y)
P142(x,y) ⊃ P16(x,y)

TO (new)

P142 used constituent (was used in)

Domain: E15 Identifier Assignment
Range: E90 Symbolic Object
Subproperty of: E7 Activity. P16 used specific object (was used for): E70 Thing
Quantification: (0:n,0:n)

Scope note: This property associates an instance of E15 Identifier Assignment with the instance of E90 Symbolic Object used as constituent of an instance of E42 Identifier in this act of assignment.

Examples:

- On June 1, 2001 assigning the personal name identifier "Guillaume, de Machaut, ca. 1300-1377" (E15) *used constituent* "ca. 1300-1377" (E41)
- Assigning a uniform title to the anonymous textual work known as 'The Adoration of the Shepherds'(E15) *used constituent* 'Coventry' (E41)
- Assigning a uniform title to Pina Bausch's choreographic work entitled 'Rite of spring' (E15) used constituent '(Choreographic Work: Bausch)'(E90)
- Assigning a uniform title to the motion picture directed in 1933 by Merian C. Cooper and Ernest B. Schoedsack and entitled 'King Kong' (E15) *used constituent* '1933' (E41)
- Assigning the corporate name identifier 'Univerza v Ljubljani. Oddelek za bibliotekarstvo' to The Department for library science of the University of Ljubljana (E15) *used constituent* 'Univerza v Ljubljani' (E42)

In First Order Logic:

P142(x,y) ⊃ E15(x)
P142(x,y) ⊃ E90(y)
P142(x,y) ⊃ P16(x,y)

P167 at (was at place of) [D: E93 Presence, R: E53 Place]

DECISION: The sig added the quantification that was previously missing from the property definition. The quantification was set to (1,n:0,n).

The decision must inform issues 459 (intro to the CRM, modelling principles), as the property appears on figure 5(current). It must also inform issues 471 and 457 because the figures that need be produced must include the cardinality of the properties.

P179 had sales price

DECISION: The sig added the quantification that was previously missing from the property definition. The quantification was set to (0,n:1,n).

DECISION: the definition of P179 changed

FROM (old)

P179 had sales price (was sales price of)

Domain: E96 Purchase

Range: E97 Monetary Amount

Subproperty of:

Quantification:

Scope note: This property establishes the relationship between an instance of E96 Purchase and the instance of E97 Monetary Amount that forms the compensation for the transaction.

Examples:

- The sale of Vincent van Gogh's "Vase with Fifteen Sunflowers" on 1987/03/30 (E96) had sales price Christies' hammer price for "Vase with Fifteen Sunflowers" (E97).

In First Order Logic:

P179(x,y) ⊃ E96(x)

P179(x,y) ⊃ E97(y)

TO (new)

P179 had sales price (was sales price of)

Domain: E96 Purchase

Range: E97 Monetary Amount

Subproperty of:

Quantification: 0,n:1,n

Scope note: This property establishes the relationship between an instance of E96 Purchase and the instance of E97 Monetary Amount that forms the compensation for the transaction.

The monetary amount agreed on may change in the course of the purchace activity.

Examples:

- The sale of Vincent van Gogh's "Vase with Fifteen Sunflowers" on 1987/03/30 (E96) had sales price Christies' hammer price for "Vase with Fifteen Sunflowers" (E97).

In First Order Logic:

P179(x,y) ⊃ E96(x)

P179(x,y) ⊃ E97(y)

P180 has currency (was currency of) [D: E97 Monetary Amount, R: E98 Currency]

DECISION: The sig added the quantification that was previously missing from the property definition. The quantification was set to (1,1:0,n).

ISSUE 458: Proofreading of scope notes of P79-P80-P81-P82

DECISION: the sig reviewed the edited scope note for E79 beginning is qualified by (HW by SS) and accepted proposed changes. It was decided that P79 beginning is qualified by will appear in version 7.0 of the CRM. But at the same time, a new issue must start regarding whether P79 should remain in the CIDOC-CRM or if it should be moved to CRMarcheo. The decision regarding its fate in the CRM universe will be made after version 7.0.

The minutes of ISSUE 380 during **the 43rd sig meeting** need be consulted regarding any decisions/proposals made concerning how to treat time-spans that were ongoing at the time of documentation.

The details of P79 beginning is qualified by can also be found in the appendix.

DECISION: the sig reviewed the edited scope note for E79 beginning is qualified by (HW by SS) and accepted proposed changes.

The details of P80 end is qualified by can also be found in the [appendix](#)

The HW about P81-P82 is not yet done. The scope notes remain the same in the version 7. CEO will continue to look at this and see if the scope note can be improved in versions next to 7.0.

[NEW ISSUE]: P79 beginning is qualified by; CRMbase OR CRMarcheo?

Upon discussing editorial changes on P79 beginning is qualified by, the sig decided to start a new issue regarding whether P79 should remain in the CIDOC-CRM or if it should be moved to CRMarcheo. The decision regarding its fate in the CRM universe will be made after version 7.0.

Any ideas shared among sig members (maybe March 2919 sig meeting in Heraklion) regarding the documentation of ongoing time-spans will be useful in this discussion.

ISSUE 437: Scope note and examples of E41 Appellation

DECISION: the sig accepted the new scope note and examples for E41 after editing a little. The definition of E41 Appellation now reads

NEW

E41 Appellation

Subclass of: E90 Symbolic Object

Superclass of: E35 Title

                          E42 Identifier

Scope note: This class comprises signs, either meaningful or not, or arrangements of signs following a specific syntax, that are used or can be used to refer to and identify a specific instance of some class or category within a certain context.

Instances of E41 Appellation do not identify things by their meaning, even if they happen to have one, but instead by convention, tradition, or agreement. Instances of E41 Appellation are cultural constructs; as such, they have a context, a history, and a use in time and space by some group of users. A given instance of E41 Appellation can have alternative forms, i.e., other instances of E41 Appellation that are always regarded as equivalent independent from the thing it denotes.

Different languages may use different appellations for the same thing, such as the names of major cities. Some appellations may be formulated using a valid noun phrase of a particular language. In these cases, the respective instances of E41 Appellation should also be declared as instances of E33 Linguistic Object. Then the language using the appellation can be declared with the property P72 has language: E56 Language.

Instances of E41 Appellation may be used to identify any instance of E1 CRM Entity and sometimes are characteristic for instances of more specific subclasses E1 CRM Entity, such as for instances of E52 Time-Span (for instance "dates"), E39 Actor, E53 Place or E28 Conceptual Object. Postal addresses and E-mail addresses are characteristic examples of identifiers used by services transporting things between clients.

Even numerically expressed identifiers for extents in space or time are also regarded as instances of E41 Appellation, such as Gregorian dates or spatial coordinates, even though they allow for determining some time or location by a known procedure starting from a reference point and by virtue of that play a double role as instances of E59 Primitive Value.

E41 Appellation should not be confused with the act of naming something. Cf. E15 Identifier Assignment

Examples:

- "Martin"
- "Aquae Sulis Minerva"
- "the Merchant of Venice" (E35) (McCullough, 2005)
- "Spigelia marilandica (L.) L." [not the species, just the name] (Hershberger, Jenkins and Robacker, 2015)
- "information science" [not the science itself, but the name through which we refer to it in an English-speaking context]
- "安" [Chinese "an", meaning "peace"]
- "6°5'29"N 45°12'13"W" (example of spatial coordinate)
- "Black queen's bishop 4" [chess coordinate] (example of spatial coordinate)
- "19-MAR-1922" (example of date)
- "+41 22 418 5571" (example of contact point)
- "weasel@paveprime.com" (example of contact point)
- "CH-1211, Genève" (example of place appellation)
- "1-29-3 Otsuka, Bunkyo-ku, Tokyo, 121, Japan" (example of address)
- "the poop deck of H.M.S Victory" (example of section definition)
- "the Venus de Milo's left buttock" (example of section definition)

In First Order Logic:

E41(x) ⊃ E90(x)

Properties:

P139 has alternative form: E41 Appellation

(P139.1 has type: E55 Type)

OLD

E41 Appellation

Subclass of: E90 Symbolic Object

Superclass of: E35 Title

E42 Identifier

Scope note: This class comprises signs, either meaningful or not, or arrangements of signs following a specific syntax, that are used or can be used to refer to and identify a specific instance of some class or category within a certain context.

Instances of E41 Appellation do not identify things by their meaning, even if they happen to have one, but instead by convention, tradition, or agreement. Instances of E41 Appellation are cultural constructs; as such, they have a context, a history, and a use in time and space by some group of users. A given instance of E41 Appellation can have alternative forms, i.e., other instances of E41 Appellation that are always regarded as equivalent independent from the thing it denotes.

Even though instances of E41 Appellation are not words of a language, different language groups may use different appellations for the same thing, such as the names of major cities. Some appellations may be formulated using a valid noun phrase of a particular language. In these cases, the respective instances of E41 Appellation should also be declared as instances of E33 Linguistic Object. Then the language group using the appellation can be declared with the property P72 has language: E56 Language.

Instances of E41 Appellation may be used to identify any instance of E1 CRM Entity and sometimes are characteristic for instances of more specific subclasses E1 CRM Entity, such as for instances of E52 Time-Span (for instance "dates"), E39 Actor, E53 Place or E28 Conceptual Object. Postal addresses and E-mail addresses are characteristic examples of identifiers used by services transporting things between clients.

Even numerically expressed identifiers in continua are also regarded as instances of E41 Appellation, such as Gregorian dates or spatial coordinates, even though they allow for determining the time or spot or are they identify by a known procedure starting from a reference point and by virtue of that play a double role as instances of E59 Primitive Value.

E41 Appellation should not be confused with the act of naming something. Cf. E15 Identifier Assignment

Examples:

- "Martin"
- "Aquae Sulis Minerva"
- "the Merchant of Venice" (E35) (McCullough, 2005)
- "Spigelia marilandica (L.) L." [not the species, just the name] (Hershberger, Jenkins and Robacker, 2015)
- "information science" [not the science itself, but the name through which we refer to it in an English-speaking context]
- "安" [Chinese "an", meaning "peace"]
- "6°5'29"N 45°12'13"W" (example of spatial coordinate)
- "Black queen's bishop 4" [chess coordinate] (example of spatial coordinate)
- "19-MAR-1922" (example of date)
- "+41 22 418 5571" (example of contact point)
- "weasel@paveprime.com" (example of contact point)
- "CH-1211, Genève" (example of place appellation)
- "1-29-3 Otsuka, Bunkyo-ku, Tokyo, 121, Japan" (example of address)
- "the poop deck of H.M.S Victory" (example of section definition)
- "the Venus de Milo's left buttock" (example of section definition)

In First Order Logic:

$$E41(x) \supset E90(x)$$

Properties:
P139 has alternative form: E41 Appellation
     (P139.1 has type: E55 Type)

ISSUE 438: proposal to replace E18 IsA E92 and E4 IsA E92 with properties

The sig reviewed the HW by MD on classes and properties affected by declaring E18 IsA E92 NOT to be the case. The classes and properties reviewed were E18 Physical Thing, E92 Spacetime Volume, E93 Presence, P161 has spatial projection, P195 had presence, P196 defines.

E18 Physical Thing

DECISION: The sig accepted the amendments to the scope note, as proposed by MD. The scope note for E18 Physical Thing changed

FROM (old)

E18 Physical Thing

Subclass of: E72 Legal Object
                 E92 Spacetime Volume

Superclass of: E19 Physical Object
                 E24 Physical Human-Made Thing

E26 Physical Feature

Scope Note:
This class comprises all persistent physical items with a relatively stable form, human-made or natural.

Depending on the existence of natural boundaries of such things, the CIDOC CRM distinguishes the instances of E19 Physical Object from instances of E26 Physical Feature, such as holes, rivers, pieces of land etc. Most instances of E19 Physical Object can be moved (if not too heavy), whereas features are integral to the surrounding matter.

An instance of E18 Physical Thing occupies not only a particular geometric space at any instant of its existence, but in the course of its existence it also forms a trajectory through spacetime, which occupies a real, that is phenomenal, volume in spacetime. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces, such as the interior of a box. Physical things consisting of aggregations of physically unconnected objects, such as a set of chessmen, occupy a number of individually contiguous spacetime volumes equal to the number of unconnected objects that constitute the set.

We model E18 Physical Thing to be a subclass of E72 Legal Object and of E92 Spacetime Volume. The latter is intended as a phenomenal spacetime volume as defined in CRMgeo (Doerr and Hiebel 2013). By virtue of this multiple inheritance we can discuss the physical extent of an instance of E18 Physical Thing without representing each instance of it together with an instance of its associated spacetime volume. This model combines two quite different kinds of substance: an instance of E18 Physical Thing is matter while an instance of E92 Spacetime Volume is an aggregation of points in spacetime. However, the real spatiotemporal extent of an instance of E18 Physical Thing is regarded to be unique to it, due to all its details and fuzziness; its identity and existence depends uniquely on the identity of the instance of E18 Physical Thing. Therefore this multiple inheritance is unambiguous and effective and furthermore corresponds to the intuitions of natural language.

The CIDOC CRM is generally not concerned with amounts of matter in fluid or gaseous states

Examples:

- the Cullinan Diamond (E19) (Scarratt and Shor, 2006)
- the cave "Ideon Andron" in Crete (E26) (Smith, 1844-49)
- the Mona Lisa (E22) (Mohem, 2006)

In First Order Logic:
E18(x) ⊃ E72(x)
E18(x) ⊃ E92(x)

Properties:
P44 has condition (is condition of): E3 Condition State
P45 consists of (is incorporated in): E57 Material
P46 is composed of (forms part of): E18 Physical Thing
P49 has former or current keeper (is former or current keeper of): E39 Actor
P50 has current keeper (is current keeper of): E39 Actor
P51 has former or current owner (is former or current owner of): E39 Actor
P52 has current owner (is current owner of): E39 Actor
P53 has former or current location (is former or current location of): E53 Place
P59 has section (is located on or within): E53 Place
P128 carries (is carried by): E90 Symbolic Object

P156 occupies (is occupied by): E53 Place

E18 Physical Thing

Subclass of: E72 Legal Object
     E92 Spacetime Volume

Superclass of: E19 Physical Object
     E24 Physical Human-Made Thing
     E26 Physical Feature

Scope Note: This class comprises all persistent physical items with a relatively stable form, human-made or natural.

Depending on the existence of natural boundaries of such things, the CIDOC CRM distinguishes the instances of E19 Physical Object from instances of E26 Physical Feature, such as holes, rivers, pieces of land etc. Most instances of E19 Physical Object can be moved (if not too heavy), whereas features are integral to the surrounding matter.

An instance of E18 Physical Thing occupies not only a particular geometric space at any instant of its existence, but in the course of its existence it also forms a trajectory through spacetime, which occupies a real, that is phenomenal, volume in spacetime. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces, such as the interior of a box. For the purpose of more detailed descriptions of the presence of an instance of E18 Physical Thing in space and time it can be associated with its specific instance of E92 Spacetime Volume by the property *P196 defines (is defined by)*.

The CIDOC CRM is generally not concerned with amounts of matter in fluid or gaseous states, as long as they are not confined in an identifiable way for an identifiable minimal time-span.

Examples:

- the Cullinan Diamond (E19) (Scarratt and Shor, 2006)
- the cave "Ideon Andron" in Crete (E26) (Smith, 1844-49)
- the Mona Lisa (E22) (Mohem, 2006)

In First Order Logic:
     E18(x) ⊃ E72(x)

Properties:
     P44 has condition (is condition of): E3 Condition State
     P45 consists of (is incorporated in): E57 Material
     P46 is composed of (forms part of): E18 Physical Thing
     P49 has former or current keeper (is former or current keeper of): E39 Actor
     P50 has current keeper (is current keeper of): E39 Actor
     P51 has former or current owner (is former or current owner of): E39 Actor
     P52 has current owner (is current owner of): E39 Actor
     P53 has former or current location (is former or current location of): E53 Place
     P59 has section (is located on or within): E53 Place
     P128 carries (is carried by): E90 Symbolic Object
     P156 occupies (is occupied by): E53 Place

P196 defines (is defined by) : E92 Spacetime Volume

E92 Spacetime Volume
DECISION: The sig accepted the amendments to the scope note, as proposed by MD. The scope note for E92 Spacetime Volume changed

FROM (old)
E92 Spacetime Volume

Subclass of: E1 CRM Entity
Superclass of: E4 Period
                  E18 Physical Thing
                  E93 Presence

Scope note: This class comprises 4 dimensional point sets (volumes) in physical spacetime (in contrast to mathematical models of it) regardless their true geometric forms. They may derive their identity from being the extent of a material phenomenon or from being the interpretation of an expression defining an extent in spacetime. Intersections of instances of E92 Spacetime Volume, E53 Place and E52 Time-span are also regarded as instances of E92 Spacetime Volume. An instance of E92 Spacetime Volume is either contiguous or composed of a finite number of contiguous subsets. Its boundaries may be fuzzy due to the properties of the phenomena it derives from or due to the limited precision up to which defining expression can be identified with a real extent in spacetime. The duration of existence of an instance of E90 Spacetime Volume is its projection on time.

Examples:

- the extent in space and time of the Event of Caesar's murder
- where and when the carbon 14 dating of the "Schoeninger Speer II" in 1996 took place
- the spatio-temporal trajectory of the H.M.S. Victory from its building to its actual location
- the extent in space and time defined by a polygon approximating the Danube river flood in Austria between 6th and 9th of August 2002

In First Order Logic:

$E92(x) \supset E1(x)$

Properties:

P10 falls within (contains): E92 Spacetime Volume
P132 spatiotemporally overlaps with: E92 Spacetime Volume
P133 spatiotemporally separated from: E92 Spacetime Volume
P160 has temporal projection(is temporal projection of): E52 Time-Span
P161 has spatial projection (is spatial projection of): E53 Place

TO (new)
E92 Spacetime Volume

Subclass of: E1 CRM Entity
Superclass of: E4 Period
                  E93 Presence

Scope note: This class comprises 4 dimensional point sets (volumes) in physical spacetime (in contrast to mathematical models of it) regardless their true geometric forms. They may derive their identity from being the extent of a material phenomenon or from being the interpretation of an expression defining an extent in spacetime. Intersections of instances of E92 Spacetime Volume, E53 Place and E52 Time-Span are also regarded as instances of E92 Spacetime Volume. An instance of E92 Spacetime Volume is either contiguous or composed of a finite number of contiguous subsets. Its boundaries may be fuzzy due to the properties of the

phenomena it derives from or due to the limited precision up to which defining expression can be identified with a real extent in spacetime. The duration of existence of an instance of E92 Spacetime Volume is its projection on time.

Examples:

- the extent in space and time of the Event of Caesar's murder
- where and when the carbon 14 dating of the "Schoeninger Speer II" in 1996 took place
- the spatio-temporal trajectory of the H.M.S. Victory from its building to its actual location
- the extent in space and time defined by a polygon approximating the Danube river flood in Austria between 6th and 9th of August 2002

In First Order Logic:

$E92(x) \supset E1(x)$

Properties:

P10 falls within (contains): E92 Spacetime Volume
P132 spatiotemporally overlaps with: E92 Spacetime Volume
P133 spatiotemporally separated from: E92 Spacetime Volume
P160 has temporal projection(is temporal projection of): E52 Time-Span
P161 has spatial projection (is spatial projection of): E53 Place

E93 Presence

DECISION: The sig accepted the amendments to the definition of the class, as proposed by MD. The definition for E93 Presence changed

FROM (old)

Subclass of: E92 Spacetime Volume

Scope note: This class comprises instances of E92 Spacetime Volume, whose temporal extent has been chosen in order to determine the spatial extent of a phenomenon over the chosen time-span. Respective phenomena may, for instance, be historical events or periods, but can also be the diachronic extent and existence of physical things. In other words, instances of this class fix a slice of another instance of E92 Spacetime Volume in time.

The temporal extent of an instance of E93 Presence typically is predetermined by the researcher so as to focus the investigation particularly on finding the spatial extent of the phenomenon by testing for its characteristic features. There are at least two basic directions such investigations might take. The investigation may wish to determine where something was during some time or it may wish to reconstruct the total passage of a phenomenon's spacetime volume through an examination of discrete presences. Observation and measurement of features indicating the presence or absence of a phenomenon in some space allows for the progressive approximation of spatial extents through argumentation typically based on inclusion, exclusion and various overlaps.

In First Order Logic:

$E93(x) \supset E92(x)$

Properties:

P164 during (was time-span of): E52 Time Span
P166 was a presence of (had presence): E92 Space Time Volume
P167 at (was place of): E53 Place

TO (new)

E93 Presence

Subclass of: E92 Spacetime Volume

Scope note: This class comprises instances of E92 Spacetime Volume, whose temporal extent has been chosen in order to determine the spatial extent of a phenomenon over the chosen time-span. Respective phenomena may, for instance, be historical events or periods, but can also be the diachronic extent and existence of physical things. In other words, instances of this class fix a slice of another instance of E92 Spacetime Volume in time.

The temporal extent of an instance of E93 Presence typically is predetermined by the researcher so as to focus the investigation particularly on finding the spatial extent of the phenomenon by testing for its characteristic features. There are at least two basic directions such investigations might take. The investigation may wish to determine where something was during some time or it may wish to reconstruct the total passage of a phenomenon's spacetime volume through an examination of discrete presences. Observation and measurement of features indicating the presence or absence of a phenomenon in some space allows for the progressive approximation of spatial extents through argumentation typically based on inclusion, exclusion and various overlaps.

In First Order Logic:
        $E93(x) \supset E92(x)$

Properties:

        P164 during (was time-span of): E52 Time Span
        P166 was a presence of (had presence): E92 Space Time Volume
        P167 at (was place of): E53 Place
        P195 was a presence of (had presence): E18 Physical Thing

P156 occupies (is occupied by

The sig accepted the amendments to the definition of the class, as proposed by MD. The definition changed

From (old)

P156 occupies (is occupied by)
Domain: E18 Physical Thing

Range: E53 Place

Subproperty of: E92 Spacetime Volume. P161 has spatial projection: E53 Place

Quantification: one to one (0,1:1,1)

Scope note: This property describes the largest volume in space, an instance of E53 Place, that an instance of E18 Physical Thing has occupied at any time during its existence, with respect to the reference space relative to itself. This allows you to describe the thing itself as a place that may contain other things, such as a box that may contain coins. In other words, it is the volume that contains all the points which the thing has covered at some time during its existence. In the case of an instance of E26 Physical Feature the default reference space is the one in which the object that bears the feature or at least the surrounding matter of the feature is at rest. In this case there is a 1:1 relation of E26 Feature and E53 Place. For simplicity of implementation multiple inheritance (E26 Physical Feature IsA E53 Place) may be a practical approach.

For instances of E19 Physical Objects the default reference space is the one which is at rest to the object itself, i.e. which moves together with the object. We include in

the occupied space the space filled by the matter of the physical thing and all its inner spaces.

This property is a subproperty of P161 has spatial projection because it refers to its own domain as reference space for its range, whereas P161 has spatial projection may refer to a place in terms of any reference space. For some instances of E18 Physical Object the relative stability of form may not be sufficient to define a useful local reference space, for instance for an amoeba. In such cases the fully developed path to an external reference space and using a temporal validity component may be adequate to determine the place they have occupied.

In contrast to P156 occupies, the property P53 has former or current location identifies an instance of E53 Place at which a thing is or has been for some unspecified time span. Further it does not constrain the reference space of the referred instance of P53 Place.

In First Order Logic:

$$P156 (x,y) = [E18(x) \land E53(y) \land P161(x,y) \land P157(y,x)]$$

TO (new)

P156 occupies (is occupied by)
Domain: E18 Physical Thing

Range: E53 Place

Subproperty of: P157i is at rest relative to (provides reference space for).

Subproperty of: P53 has former or current location (is former or current location of)

Quantification: one to one (0,1:1,1)

Scope note: This property describes the largest volume in space, an instance of E53 Place, that an instance of E18 Physical Thing has occupied at any time during its existence, with respect to the reference space relative to the physical thing itself. This allows for describing the thing itself as a place that may contain other things, such as a box that may contain coins. In other words, it is the volume that contains all the points which the thing has covered at some time during its existence. The reference space for the associated place must be the one that is permanently at rest (*P157 is at rest relative to)* relative to the physical thing. For instances of E19 Physical Objects it is the one which is at rest relative to the object itself, i.e. which moves together with the object. For instances of E26 Physical Feature it is one which is at rest relative to the physical feature itself and the surrounding matter immediately connected to it. Therefore there is a 1:1 relation between the instance E18 Physical Thing and the instance of E53 Place it occupies. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces.

This property implies the fully developed path from E18 Physical Thing through *P196 defines, E92 Spacetime Volume*, *P161 has spatial projection*, E53 Place. However, in contrast to *P156 occupies,* the property *P161 has spatial projection* does not constrain the reference space of the referred instance of E53 Place.

In contrast to *P156 occupies*, for the property *P53 has former or current location* the following holds:

- It does not constrain the reference space of the referred instance of E53 Place.
- It identifies a possibly wider instance of E53 Place at which a thing is or has been for some unspecified time span.
- If the reference space of the referred instance of E53 Place is not at rest with respect to the physical thing found there, the physical thing may move away after some time to another place and/or may have been at some other place before. The same holds for the fully developed path from E18 Physical Thing through *P196 defines, E92 Spacetime Volume*, *P161 has spatial projection*, E53 Place.

In First Order Logic:

$$P156(x,y) \supset E53(y)$$

$$P156(x,y) \supset E18(x)$$

$$P156 (x,y) = [E18(x) \land E53(y) \land P196(x,z) \land P161(z,y) \land P157(y,x)]$$

P161 has spatial projection

DECISION: The sig accepted the amendments to the scope note, as proposed by MD. The scope note for P161 has spatial projection changed

FROM (old)

P161 has spatial projection (is spatial projection of)
Domain: E92 Spacetime Volume
Range: E53 Place
Superproperty of: E18 Physical Thing. P156 occupies (is occupied by): E53 Place
Quantification: one to many, necessary, dependent (1,n:1,1)

Scope note: This property associates an instance of an instance of E92 Spacetime Volume with an instance of E53 Place that is the result of the spatial projection of the instance of the E92 Spacetime Volume on a reference space.

In general there can be more than one useful reference space (for reference space see p156 occupies and p157 is at rest relative to) to describe the spatial projection of a spacetime volume, for example, in describing a sea battle, the difference between the battle ship and the seafloor as reference spaces. Thus it can be seen that the projection is not unique.

The spatial projection is the actual spatial coverage of a spacetime volume, which normally has fuzzy boundaries except for instances of E92 Spacetime Volumes which are geometrically defined in the same reference system as the range of this property are an exception to this

and do not have fuzzy boundaries. Modelling explicitly fuzzy spatial projections serves therefore as a common topological reference of different spatial approximations rather than absolute geometric determination, for instance for relating outer or inner spatial boundaries for the respective spacetime volumes.

In case the domain of an instance of P161 has spatial projection is an instance of E4 Period, the spatial projection describes all areas that period was ever present at, for instance, the Roman Empire. In case the domain of an instance of *P161 has spatial projection* is an instance of E19 Physical Object, the spatial projection has to be understood as the complete path along which the object has or has been moved during its existence.

This property is part of the fully developed path from E4 Period through P161 has spatial projection, E53 Place, P89 falls within (contains) to E53 Place, which in turn is shortcut by P7took place at (witnessed.)

Example:

- The Roman Empire P161 has spatial projection all areas ever claimed by Rome.

In First Order Logic:

P161(x,y) ⊃ E92(x)
P161(x,y) ⊃ E53(y)

TO (new)

P161 has spatial projection (is spatial projection of)
Domain: E92 Spacetime Volume
Range: E53 Place
Quantification: one to many, necessary, dependent (1,n:1,1)

Scope note: This property associates an instance of an instance of E92 Spacetime Volume with an instance of E53 Place that is the result of the spatial projection of the instance of the E92 Spacetime Volume on a reference space.

In general, there can be more than one useful reference space (for reference space see p156 occupies and p157 is at rest relative to) to describe the spatial projection of a spacetime volume, for example, in describing a sea battle, the difference between the battle ship and the seafloor as reference spaces. Thus, it can be seen that the projection is not unique.

The spatial projection is the actual spatial coverage of a spacetime volume, which normally has fuzzy boundaries except for instances of E92 Spacetime Volumes which are geometrically defined in the same reference system as the range of this property are an exception to this and do not have fuzzy boundaries. Modelling explicitly fuzzy spatial projections serves therefore as a common topological reference of different spatial approximations rather than absolute geometric determination, for instance for relating outer or inner spatial boundaries for the respective spacetime volumes.

In case the domain of an instance of P161 has spatial projection is an instance of E4 Period, the spatial projection describes all areas that period was ever present at, for instance, the Roman Empire.

This property is part of the fully developed path from E18 Physical Thing through *P196 defines,* E92 Spacetime Volume, *P161 has spatial projection*, which in turn is implied by *P156 occupies (is occupied by)*

This property is part of the fully developed path from E4 Period through P161 has spatial projection, E53 Place, *P89 falls within (contains)* to E53 Place, which in turn is shortcut by *P7took place at (witnessed)*.

Example:

- The Roman Empire P161 has spatial projection all areas ever claimed by Rome.

In First Order Logic:

P161(x,y) ⊃ E92(x)
P161(x,y) ⊃ E53(y)

P195 was a presence of (had presence)

DECISION: The sig accepted the definition of the new property with minor editorial changes as proposed by MD.

P195 was a presence of (had presence)
Domain: E93 Presence
Range: E18 Physical Thing
Quantification: (1,1: 0,n)

Scope note: This property associates an instance of E93 Presence with the instance of E18 Physical Thing of which it represents a temporal restriction (i.e.: a time-slice) of the thing's trajectory through spacetime. In other words, it describes where the instance of E18 Physical Thing was or moved around during a given time-span. Instantiating this property constitutes a necessary part of the identity of the respective instance of E93 Presence.

This property is a shortcut of the fully developed path from E18 Physical Thing through *P196 defines,* E92 Spacetime Volume, *P166 was a presence of,* E93 Presence.

In First Order Logic:

P195(x,y) ⊃ E93(x),
P195(x,y) ⊃ E18(y),
P195(x,y) = (∃z)[E9(z) ∧ P196 (y,z) ∧ P166(z,x)]

P196 defines (is defined by)

DECISION: The sig accepted the definition of the new property with minor editorial changes as proposed by MD.

P196 defines (is defined by)
Domain: E18 Physical Thing
Range: E92 Spacetime Volume
Quantification: one to one, necessary (1,1:0,1)

Scope note: This property associates an instance of E18 Physical Thing with the instance of E92 Spacetime Volume that constitutes the complete trajectory of its geometric extent through spacetime for the whole time of the existence of the instance of E18 Physical Thing.

An instance of E18 Physical Thing not only occupies a particular geometric space at each instant of its existence, but in the course of its existence it also forms a trajectory through spacetime, which occupies a real, that is phenomenal, volume in spacetime, i.e., the instance of E92 Spacetime Volume this property associates it with. This real spatiotemporal extent of the instance of E18 Physical Thing is regarded as being unique, in all its details and fuzziness; the identity and existence of the E92 Spacetime Volume depends uniquely on the identity of the instance of E18 Physical Thing, whose existence defines it. It constitutes a phenomenal spacetime volume as defined in CRMgeo (Doerr and Hiebel 2013).

Included in this spacetime volume are both the spaces filled by the matter of the physical thing and any inner space that may exist, for instance the interior of a box. Physical things

consisting of aggregations of physically unconnected objects, such as a set of chessmen, occupy a finite number of individually contiguous subsets of this spacetime volume equal to the number of objects that constitute the set and that are never connected during its existence.

In First Order Logic:

$$P196(x,y) \supset E18(x)$$
$$P196(x,y) \supset E92(y)$$

ISSUE 433: Scope note of E77 Persistent Item

DECISION: The sig reviewed the amended scope note for E77 Persistent Item (HW by SS), did some more editing and accepted it. The scope note changed

FROM (old)

E77 Persistent Item

Subclass of: E1 CRM Entity

Superclass of: E39 Actor

                 E70 Thing

Scope note: This class comprises items that have persistent characteristics of structural nature substantially related to their identity and their integrity, sometimes known as "endurants" in philosophy. Persistent Items may be physical entities, such as people, animals or things, conceptual entities such as ideas, concepts, products of the imagination or even names.

Instances of E77 Persistent Item may be present or be part of interactions in different periods or events. They can repeatedly be recognized at disparate occasions during their existence by characteristics of structural nature. The respective characteristics need not be exactly the same during all the existence of an instance of E77 Persistent Item. Often, they undergo gradual change, still bearing some similarities with that of previous times, or disappear completely and new emerge. For instance, a person, from the time of being born on, will gradually change all its features and acquire new ones, such as a scar. Even the DNA in different body cells will develop defects and mutations. Nevertheless, relevant characteristics use to be sufficiently similar to recognize the instance for some substantial period of time.

The more specific criteria that determine the identity of instances of subclasses of E77 Persistent Item may vary considerably and are described of referred to in the respective scope notes. The decision about which exact criteria to use depends on whether the observable behaviour of the respective part of reality such confined conforms to the reasoning the user is interested in. For example, a building can be regarded as no longer existing if it is dismantled and the materials reused in a different configuration. On the other hand, human beings go through radical and profound changes during their life-span, affecting both material composition and form, yet preserve their identity by other criteria, such as being bodily separated from other persons. Similarly, inanimate objects may be subject to exchange of parts and matter. On the opposite, the identity of a (version of a) text of a scientific publication is given by the exact arrangement of its relevant symbols.

The main classes of objects that fall outside the scope the E77 Persistent Item class are temporal objects such as periods, events and acts, and descriptive properties.

An instance of E77 Persistent Item does not require actual knowledge of the identity of the instance being currently known. There may be cases, where the actual identity of an instance of E77 Persistent Item is not decidable at a particular state of knowledge.

Examples:

- Leonard da Vinci (Strano, 1953)
- Stonehenge (Richards, 2005)
- the hole in the ozone layer (Hufford and Horwitz, 2005)
- the First Law of Thermodynamics (Craig and Gislason, 2002)
- the Bermuda Triangle (Dolan, 2005)

In First Order Logic:

$$E77(x) \supset E1(x)$$

TO (new)

E77 Persistent Item

Subclass of: E1 CRM Entity

Superclass of: E39 Actor

                 E70 Thing

Scope note: This class comprises items that have persistent characteristics of structural nature substantially related to their identity and their integrity, sometimes known as "endurants" in philosophy. Persistent Items may be physical entities, such as people, animals or things, conceptual entities such as ideas, concepts, products of the imagination or even names.

Instances of E77 Persistent Item may be present or be part of interactions in different periods or events. They can repeatedly be recognized at disparate occasions during their existence by characteristics of structural nature. The respective characteristics need not be exactly the same during all the existence of an instance of E77 Persistent Item. Often, they undergo gradual change, still bearing some similarities with that of previous times, or disappear completely and new emerge. For instance, a person, from the time of being born on, will gradually change all its features and acquire new ones, such as a scar. Even the DNA in different body cells will develop defects and mutations. Nevertheless, relevant characteristics use to be sufficiently similar to recognize the instance for some substantial period of time.

The more specific criteria that determine the identity of instances of subclasses of E77 Persistent Item may vary considerably and are described of referred to in the respective scope notes. The decision about which exact criteria to use depends on whether the observable behaviour of the respective part of reality such confined conforms to the reasoning the user is interested in. For example, a building can be regarded as no longer existing if it is dismantled and the materials reused in a different configuration. On the other hand, human beings go through radical and profound changes during their life-span, affecting both material composition and form, yet preserve their identity by other criteria, such as being bodily separated from other persons. Similarly, inanimate objects may be subject to exchange of parts and matter. On the opposite, the identity of a (version of a) text of a scientific publication is given by the exact arrangement of its relevant symbols.

The main classes of objects that fall outside the scope of the E77 Persistent Item class are temporal objects such as periods, events and acts, and descriptive properties.

An instance of E77 Persistent Item does not require actual knowledge of the identifying features of the instance being currently known. There may be cases, where the actual identifying features of an instance of E77 Persistent Item are not decidable at a particular state of knowledge.

Examples:

- Leonard da Vinci (Strano, 1953)
- Stonehenge (Richards, 2005)
- the hole in the ozone layer (Hufford and Horwitz, 2005)
- the First Law of Thermodynamics (Craig and Gislason, 2002)

- the Bermuda Triangle (Dolan, 2005)

In First Order Logic:

$$E77(x) \supset E1(x)$$

ISSUE 451: scope note of P46 is composed of

DECISION: the sig accepted MD's proposal to add a phrase that captures the relation among the spatial extent of the composing parts and the whole they form. The scope note changed

FROM (old)

P46 is composed of (forms part of)

Domain: E18 Physical Thing
Range: E18 Physical Thing
Subproperty of: E92 Spacetime Volume. P132 spatiotemporally overlaps with: E92 Spacetime Volume
Superproperty of: E19 Physical Object. P56 bears feature (is found on): E26 Physical Feature
Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E18 Physical Thing with another instance of Physical Thing that forms part of it.

Component elements, since they are themselves instances of E18 Physical Thing, may be further analysed into sub-components, thereby creating a hierarchy of part decomposition. An instance of E18 Physical Thing may be shared between multiple wholes, for example two buildings may share a common wall. This property does not specify when and for how long a component element resided in the respective whole. If a component is not part of a whole from the beginning of existence or until the end of existence of the whole, the classes E79 Part Addition and E90 Part Removal can be used to document when a component became part of a particular whole and/or when it stopped being a part of it. For the time-span of being part of the respective whole, the component is completely contained in the place the whole occupies.

This property is intended to describe specific components that are individually documented, rather than general aspects. Overall descriptions of the structure of an instance of E18 Physical Thing are captured by the P3 has note property.

The instances of E57 Material of which an item of E18 Physical Thing is composed should be documented using P45 consists of (is incorporated in).

Examples:
- the Royal carriage (E22) forms part of the Royal train (E22)
- the "Hog's Back" (E24) forms part of the "Fosseway" (E24)

In First Order Logic:
P46(x,y) ⊃ E18(x)
P46(x,y) ⊃ E18(y)
P46(x,y) ⊃ P132(x,y)
P46(x,y) ⊃ (∃uzw)[E93(u) ∧ P166 (x,u) ∧ E52(z) ∧ P164(u,z) ∧ E93(w) ∧ P166 (y,w) ∧ P164(w,z) ∧ P10(w,u)]

TO (new)

P46 is composed of (forms part of)

Domain: E18 Physical Thing
Range: E18 Physical Thing
Subproperty of:

Superproperty of: E19 Physical Object. P56 bears feature (is found on): E26 Physical Feature
Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E18 Physical Thing with another instance of Physical Thing that forms part of it. The spatial extent of the composing part is included in the spatial extent of the whole.

Component elements, since they are themselves instances of E18 Physical Thing, may be further analysed into sub-components, thereby creating a hierarchy of part decomposition. An instance of E18 Physical Thing may be shared between multiple wholes, for example two buildings may share a common wall. This property does not specify when and for how long a component element resided in the respective whole. If a component is not part of a whole from the beginning of existence or until the end of existence of the whole, the classes E79 Part Addition and E90 Part Removal can be used to document when a component became part of a particular whole and/or when it stopped being a part of it. For the time-span of being part of the respective whole, the component is completely contained in the place the whole occupies.

This property is intended to describe specific components that are individually documented, rather than general aspects. Overall descriptions of the structure of an instance of E18 Physical Thing are captured by the P3 has note property.

The instances of E57 Material of which an item of E18 Physical Thing is composed should be documented using P45 consists of (is incorporated in).

Examples:
- the Royal carriage (E22) forms part of the Royal train (E22)
- the "Hog's Back" (E24) forms part of the "Fosseway" (E24)

In First Order Logic:
P46(x,y) ⊃ E18(x)
P46(x,y) ⊃ E18(y)
P46(x,y) ⊃ P132(x,y)
P46(x,y) ⊃ (∃uzw)[E93(u) ∧ P166 (x,u) ∧ E52(z) ∧ P164(u,z) ∧ E93(w) ∧ P166 (y,w) ∧ P164(w,z) ∧ P10(w,u)]

APPENDICES

APPENDIX 1; List of abbreviated names in the text

Initials	First Name	Last Name	Institution
TA	Trond	Aalberg	NTU/OSLOMET
MA	Marta	Acierno	Sapienza Universita di Roma
GB	George	Bruseker	J. Paul Getty Trust
NC	Nicola	Carboni	University of Zurich; SARI
MD	Martin	Doerr	ICS-FORTH
KD	Korina	Doerr	ICS-FORTH
AF	Achille	Felicetti	PIN
DF	Donatella	Fiorante	Sapienza Universita di Roma
GH	Gerald	Hiebel	Universität Innsbruck
ML	Matteo	Lorenzini	ETH Zurich – GTA
CM	Carlo	Meghini	CNR
FM	Francesca	Murano	Universita di Firenze
CEO	Cristian-Emil	Ore	University of Oslo
PR	Pat	Riva	Concordia University
MR	Mélanie	Roche	Bibliothèque National de France
RS	Robert	Sanderson	J. Paul Getty Trust
SS	Stephen	Stead	Paverprime Ltd.
TV	Thanasis	Velios	University of the Arts London
MZ	Maja	Zumer	University of Ljubljana

APPENDIX 2; reference to issues/ presentations.

ISSUE 474: Editorial check of changes in CRMarcheo

A1 Excavation Process Unit.

from

A1 Excavation Processing Unit

Subclass of: S1 Matter Removal

S4 Observation

Scope Note: This class comprises activities of excavating in the sense of archaeology, which are documented as a coherent set of actions of progressively recording and removing matter from a pre-specified location under specific rules. Typically, an excavation process unit would be terminated if significant discontinuities of substance or finds come to light, or if the activity is interrupted due to external factors, such as end of a working day. In other cases, the termination would be based on predefined physical specifications, such as the boundaries of a maximal volume of matter to be excavated in one unit of excavation.

Depending on the methodology, an instance of A1 Excavation Process Unit may intend to remove matter only within the boundaries of a particular stratigraphic unit, or it may follow a pre-declared spatial extent such as a trench. It may only uncover, clean or expose a structure or parts of it.

The process of excavation results in the production of a set of recorded (documentation) data that should be sufficient to provide researchers enough information regarding the

consistence and spatial distribution of the excavated Segment of Matter and things and features embedded in it. Some parts or all of the removed physical material (S11 Amount of Matter) may be dispersed, whereas others may be kept in custody in the form of finds or samples, while others (such as parts of walls) may be left at the place of their discovery. The data produced by an instance of excavation process unit should pertain to the material state of matter at excavation time only and should be clearly distinguished from subsequent interpretation about the causes for this state of matter.

Examples:

- The activity taking place on 21.9.2007 between 12:00 and 13:00 that excavated the Stratigraphic Volume Unit (2) of Figure 4 and created the surface S1
- The activity that excavated the first 20 cm of a spit excavation on 21.7.2007 created the surface S2 in Figure 4.

In First Order Logic:

A1(x) ⊃ S1(x)

A1(x) ⊃ S4(x)

Properties:

AP1 produced (was produced by): S11 Amount of Matter

AP2 discarded (was discarded by): S11 Amount of Matter

AP4 produced surface (was surface produced by): A20 Rigid Physical Feature

AP5 removed part or all of (was partially or totally removed by): A8 Stratigraphic Unit

AP6 intended to approximate (was approximated by): A3 Stratigraphic Interface

AP10 destroyed (was destroyed by): S22 Segment of Matter (Segment of Matter that happened to be at the Excavated Place)

to

A1 Excavation Processing Unit

Subclass of: S1 Matter Removal

                S4 Observation

Scope Note: This class comprises activities of excavating in the sense of archaeology, which are documented as a coherent set of actions of progressively recording and removing matter from a pre-specified location under specific rules. Typically, an excavation process unit would be terminated if significant discontinuities of substance or finds come to light, or if the activity is interrupted due to external factors, such as end of a working day. In other cases, the termination would be based on predefined physical specifications, such as the boundaries of a maximal volume of matter to be excavated in one unit of excavation.

                Depending on the methodology, an instance of A1 Excavation Process Unit may intend to remove matter only within the boundaries of a particular stratigraphic unit, or it may follow a pre-declared spatial extent such as a trench. It may only uncover, clean or expose a structure or parts of it.

The process of excavation results in the production of a set of recorded (documentation) data that should be sufficient to provide researchers enough information regarding the consistence and spatial distribution of the excavated Segment of Matter and things and features embedded in it. Some parts or all of the removed physical material (S11 Amount of Matter) may be dispersed, whereas others may be kept in custody in the form of finds or samples, while others (such as parts of walls) may be left at the place of their discovery. The data produced by an instance of excavation process unit should pertain to the material state of matter at excavation time only and should be clearly distinguished from subsequent interpretation about the causes for this state of matter.

Examples:

- The activity taking place on 21.9.2007 between 12:00 and 13:00 that excavated the Stratigraphic Volume Unit (2) of Figure 4 and created the surface S1 (A10)
- The activity that excavated the first 20 cm of a spit excavation on 21.7.2007 created the surface S2 in Figure 4.

In First Order Logic:

A1(x) ⊃ S1(x)

A1(x) ⊃ S4(x)

Properties:

AP1 produced (was produced by): S11 Amount of Matter

AP2 discarded (was discarded by): S11 Amount of Matter

AP4 produced surface (was surface produced by): A10 Excavation Interface

AP5 removed part or all of (was partially or totally removed by): A8 Stratigraphic Unit

AP6 intended to approximate (was approximated by): A3 Stratigraphic Interface

AP10 destroyed (was destroyed by): S22 Segment of Matter

A9 Archaeological Excavation
from:
A9 Archaeological Excavation

Subclass of: S4 Observation

Scope Note: This class describes the general concept of archaeological excavation intended as a coordinated set of activities performed on an area considered as part of a broader topographical, rural, urban, or monumental context. An archaeological excavation is usually under the responsibility of a coordinator, officially designated, which is legally and scientifically responsible for all the activities carried out within each of the Excavation Processing Units and is also responsible for the documentation of the whole process.

Examples:

- The archaeological excavation (A9) of the West House (E24) that took place at the archaeological site of Akrotiri, Thera (E53) during the years (1967-1973) (E52) by the archaeologist Sp. Marinatos (E39). [Μιχαηλίδου 2001, p. 41] [Palyvou 200].

In First Order Logic:

    A9(x) ⊃ S4(x)

Properties:

    AP3 investigated (was investigated by): E53 Place

to:

A9 Archaeological Excavation

Subclass of: S4 Observation

Scope Note: This class describes the general concept of archaeological excavation intended as a coordinated set of activities performed on an area considered as part of a broader topographical, rural, urban, or monumental context. An archaeological excavation is usually under the responsibility of a coordinator, officially designated, which is legally and scientifically responsible for all the activities carried out within each of the Excavation Processing Units and is also responsible for the documentation of the whole process.

Examples:

- The archaeological excavation (A9) of the West House (E24) that took place at the archaeological site of Akrotiri, Thera (E27) during the years (1967-1973) (E52) by the archaeologist Sp. Marinatos (E39). [Μιχαηλίδου 2001, p. 41] [Palyvou 200].

In First Order Logic:

    A9(x) ⊃ S4(x)

Properties:

    AP3 investigated (was investigated by): E27 Site

AP2 discarded into (was discarded by)

version 1.4.8

AP2 discarded into (was discarded by)

Domain: A1 Excavation Process Unit
Range: S11 Amount of Matter
Subproperty of: O2 removed (was removed by)
Quantification: one to many (0,n:0,1)

Scope note: This property identifies the S11 Amount of Matter (e.g. a heap) into which material from an A1 Excavation Process Unit is discarded.

Examples:

- The Excavation Process Unit excavating the Stratigraphic Volume Unit (2) discarded   an amount of matter into the waste heap of the excavation.

In First Order Logic:

    AP2(x,y) ⊃ A1(x)
    AP2(x,y) ⊃ S11(y)
    AP2(x,y) ⊃ O2(x,y)

AP2 discarded (was discarded by)

Domain: A1 Excavation Process Unit
Range: S11 Amount of Matter
Subproperty of: O2 removed (was removed by)
Quantification: one to many (0,1:1,1)

Scope note: This property identifies the S11 Amount of Matter discarded (e.g. onto the spoil heap) by A1 Excavation Processing Unit.

Examples:

- The stratum of ash, pumice and other volcanic material removed (S11) *was discarded by* the excavation of Villa of the Mysteries in Pompeii, Italy (A1).

In First Order Logic:

$$AP2(x,y) \supset A1(x)$$
$$AP2(x,y) \supset S11(y)$$
$$AP2(x,y) \supset O2(x,y)$$

AP22 is equal in time to

Domain: E2 Temporal Entity
Range: E2 Temporal Entity
Subproperty of: E2 Temporal Entity.P175 starts before or with the start of (starts after or with the start of): E2 Temporal Entity
                E2 Temporal Entity. P184 ends before or with the end of (ends with or after the end of): E2 Temporal Entity
Quantification: many to many (0,n:0,n)

Scope note: This property symmetrically identifies a situation in which the starting point and the ending point for an instance of E2 Temporal Entity is equal to the starting point and the ending point respectively of another instance of E2 Temporal Entity.
                This property is only necessary if the time span is unknown (otherwise the equivalence can be calculated).
                This property is the same as the "equal" relationship of Allen's temporal logic (Allen, 1983, pp. 832-843).
                This property is transitive.

Example: The destruction of the Villa Justinian Tempus (E6) is equal in time to the death of Maximus Venderus (E69)

In First Order Logic:

$$AP22(x,y) \supset E2(x)$$
$$AP22(x,y) \supset E2(y)$$
$$AP22(x,y) \supset P175(y,x)$$
$$AP22(x,y) \supset P184(y,x)$$

AP23 finishes (is finished by)

Domain: E2 Temporal Entity

Range: E2 Temporal Entity

Subproperty of: E2 Temporal Entity.P184 ends before or with the end of (ends with or after the end of):E2 Temporal Entity

Quantification: many to many (0,n:0,n)

Scope note: This property identifies a situation in which the ending point of an instance of E2 Temporal Entity is equal to the ending point of another temporal entity of longer duration. There is no causal relationship implied by this property.

This property is only necessary if the time span is unknown (otherwise the relationship can be calculated). This property is the same as the "finishes / finished-by" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).

This property is transitive.

Example: Late Bronze Age (E4) *finishes* Bronze Age (E4)

In First Order Logic:

$$AP23(x,y) \supset E2(x)$$

$$AP23(x,y) \supset E2(y)$$

$$AP23(x,y) \supset P184(x,y)$$

AP24 starts (is started by)

Domain: E2 Temporal Entity

Range: E2 Temporal Entity

Subproperty of: E2 Temporal Entity.P185 ends before the end of (ends after the end of):E2 Temporal Entity

E2 Temporal Entity.P175 starts before or with the start of (starts after or with the start of):E2 Temporal Entity

Quantification: many to many (0,n:0,n)

Scope note: This property identifies a situation in which the starting point for an instance of E2 Temporal Entity is equal to the starting point of another instance of E2 Temporal Entity of longer duration
This property is only necessary if the time span is unknown (otherwise the relationship can be calculated). This property is the same as the "starts / started-by" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).
This property is transitive.

Example: Early Bronze Age (E4) *starts* Bronze Age (E4)

In First Order Logic:
$$AP24(x,y) \supset E2(x)$$
$$AP24(x,y) \supset E2(y)$$
$$AP24(x,y) \supset P175(x,y)$$
$$AP24(x,y) \supset P185(x,y)$$

AP25 occurs during (includes)

Domain: E2 Temporal Entity

Range: E2 Temporal Entity

Subproperty of: E2 Temporal Entity.P185 ends before the end of (ends after the end of):E2 Temporal Entity

Quantification: many to many (0,n:0,n)

Scope note: This property identifies a situation in which the entire instance of E52 Time-Span of an instance of E2 Temporal Entity is within the instance of E52 Time-Span of another instance of E2 Temporal Entity that starts before and ends after the included temporal entity.

                This property is only necessary if the time span is unknown (otherwise the relationship can be calculated). This property is the same as the "during / includes" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).

                This property is transitive.

Example: Middle Saxon period (E4) *occurs during* Saxon period (E4)

In First Order Logic:

$$AP25(x,y) \supset E2(x)$$

$$AP25(x,y) \supset E2(y)$$

$$AP25(x,y) \supset P185(x,y)$$

AP26 overlaps in time with (is overlapped in time by)

Domain: E2 Temporal Entity
Range: E2 Temporal Entity
Subproperty of: E2 Temporal Entity.P176 starts before the start of (starts after the start of): E2Temporal Entity

                E2 Temporal Entity.P185 ends before the end of (ends after the end of):E2 Temporal Entity
Quantification: many to many (0,n:0,n)

Scope note: This property identifies a situation in which there is an overlap between the instances of E52 Time-Span of two instances of E2 Temporal Entity.
                It implies a temporal order between the two entities: if A overlaps in time B, then A must start before B, and B must end after A. This property is only necessary if the relevant time spans are unknown (otherwise the relationship can be calculated).
                This property is the same as the "overlaps / overlapped-by" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).

Example: the Iron Age (E4) overlaps in time with the Roman period (E4)

 In First Order Logic:
$$AP26(x,y) \supset E2(x)$$
$$AP26(x,y) \supset E2(y)$$
$$AP26(x,y) \supset P176(x,y)$$
$$AP26(x,y) \supset P185(x,y)$$

AP27 meets in time with (is met in time by)

Domain: E2 Temporal Entity
Range: E2 Temporal Entity

Subproperty of: E2 Temporal Entity.P182 ends before or with the start of (starts after or with the end of):E2 Temporal Entity

Quantification: many to many (0,n:0,n)

Scope note: This property identifies a situation in which one instance of E2 Temporal Entity immediately follows another instance of E2 Temporal Entity.

It implies a particular order between the two entities: if A meets in time with B, then A must precede B. This property is only necessary if the relevant time spans are unknown (otherwise the relationship can be calculated).

This property is the same as the "meets / met-by" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).

Example: Early Saxon Period (E4) meets in time with Middle Saxon Period (E4)

In First Order Logic:

$$AP27(x,y) \supset E2(x)$$
$$AP27(x,y) \supset E2(y)$$
$$AP27(x,y) \supset P182(x,y)$$

AP28 occurs before (occurs after)

Domain: E2 Temporal Entity
Range: E2 Temporal Entity
Subproperty of: E2 Temporal Entity. P183 ends before the start of (starts after the end of): E2 Temporal Entity
Quantification: many to many (0,n:0,n)

Scope note: This property identifies the relative chronological sequence of two temporal entities.

It implies that a temporal gap exists between the end of A and the start of B. This property is only necessary if the relevant time spans are unknown (otherwise the relationship can be calculated).

This property is the same as the "before / after" relationships of Allen's temporal logic (Allen, 1983, pp. 832-843).

This property is transitive..

Example: The destruction of the Villa Justinian Tempus (E6) is equal in time to the death of Maximus Venderus (E69)

In First Order Logic:

$$AP22(x,y) \supset E2(x)$$
$$AP22(x,y) \supset E2(y)$$
$$AP22(x,y) \supset P175(y,x)$$
$$AP22(x,y) \supset P184(y,x)$$

ISSUE 360: LRMoo

TOPIC 2: Externalization, to finish

Rnn was remembered in (contains memory of) [D: F28 Expression Creation; R: F2 Expression].

DECISION: the property was edited and also a clause was added in the scope note of R20 recorded (see below).

DECISION: Instead of declaring *Rnn was remembered in* a subproperty of P16 used specific object [D: E7 Activity; R: E70 Thing], the sig opted to make it isA P67i is referred to by [D: E1 CRM Entity; R: E89 Propositional Object].

Rnn was remembered in (contains memory of)

Domain: F56 Externalization Event

Range: F2 Expression

Subproperty of: P67i is referred to by (or may be Out of CIDOC CRM scope)

Superproperty of: R17 created

Quantification: (1,n:1,n)

Scope note: This property associates an instance of F56 Externalization Event with the instance of F2 Expression that records or refers to the content of that particular externalization event, in whole or in part. This recording may be done either directly or be transferred through tradition The expression that records the externalization event may or may not be an expression of the work that was externalized in the event.

Examples:

R20 recorded (was recorded through)

DECISION: To distinguish generic recordings from recordings of instances of F56 Externalization Event, a clause was added in the scope note of R20. The scope note changed

FROM (old)

R20 recorded (was recorded through)

Domain: F29 Recording Event

Range: E2 Temporal Entity

Subproperty of: E7 Activity. P15 was influenced by (influenced): E5 Event. P9i forms part of: E5 Event. P9 consists of: E5 Event

Quantification: (1,n:0,n)

Scope note: This property associates an instance of F29 Recording Event with the instance of E2 Temporal Entity which was captured.

Examples:

- The making of the recording of the third alternate take of the musical work entitled 'Blue Hawaii' as performed by Elvis Presley in Hollywood, Calif., Radio Recorders, on March 22nd, 1961 (F29) R20 recorded Elvis Presley's performance of the musical work entitled 'Blue Hawaii' in Hollywood, Calif., Radio Recorders, on March 22nd, 1961 (F31)

TO (new)

R20 recorded (was recorded through)

Domain: F29 Recording Event

Range: E2 Temporal Entity

Subproperty of: E7 Activity. P15 was influenced by (influenced): E5 Event. P9i forms part of: E5 Event. P9 consists of: E5 Event

Quantification: (1,n:0,n)

Scope note: This property associates an instance of F29 Recording Event with the instance of E2 Temporal Entity which was captured.

In the case that the recorded temporal entity is an instance of Externalisation Event, then the recording creates a memory of it (cf. new Rnn).

Examples:

- The making of the recording of the third alternate take of the musical work entitled 'Blue Hawaii' as performed by Elvis Presley in Hollywood, Calif., Radio Recorders, on March 22nd, 1961 (F29) R20 recorded Elvis Presley's performance of the musical work entitled 'Blue Hawaii' in Hollywood, Calif., Radio Recorders, on March 22nd, 1961 (F31)

Topic 7: examples added

R10 has member (is member of)

OLD

R10 has member (is member of)

Domain: F1 Work
Range: F1 Work
Superproperty of: F1 Work. R67 has part (is part of): F1 Work
Subproperty of: E89 Propositional Object. P148 has component (is component of): E89 Propositional Object
Quantification: (0,n:0,n)

Scope note: This property associates an instance of F1 Work with another instance of F1 Work that forms a part of it. This property is transitive. An instance of F1 Work may neither directly nor indirectly be a member of itself. Instances of F1 Work that are not members of one another may not share a common member.

Examples:

- Dante's textual work entitled 'Inferno' (F1) *R10 has member* the abstract content of the pseudo-old French text of Émile Littré's translation entitled 'L'Enfer mis en vieux langage françois et en vers' [a 19th century translation of Dante's 'Inferno' into old French] published in 1879 (F1)
- Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains' (F1) *R10 has member* the abstract content of Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains: 2nd state' (F1)

NEW

R10 has member (is member of)

Domain: F1 Work
Range: F1 Work
Superproperty of: F1 Work. R67 has part (is part of): F1 Work
Subproperty of: E89 Propositional Object. P148 has component (is component of): E89 Propositional Object
Quantification: (0,n:0,n)

Scope note: This property associates an instance of F1 Work with another instance of F1 Work that forms a part of it. This property is transitive. An instance of F1 Work may neither directly nor indirectly be a member of itself. Instances of F1 Work that are not members of one another may not share a common member.

Examples:

- Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains' (F1) *R10 has member* the abstract content of Giovanni Battista Piranesi's graphic work entitled 'Carcere XVI: the pier with chains: 2nd state' (F1)
- Joseph Haydn's musical work entitled 'The Seven Last Words of Christ' (numbered Hob. XX in Anthony van Hoboken's catalogue of Joseph Haydn's works) *R10 has member* Joseph Haydn's orchestral work entitled 'The Seven Last Words of Christ', composed in 1786 (Hob. XX/1A)
- Joseph Haydn's musical work entitled 'The Seven Last Words of Christ' (numbered Hob. XX in Anthony van Hoboken's catalogue of Joseph Haydn's works) *R10 has member* Joseph Haydn's work for string quartet entitled 'The Seven Last Words of Christ', composed in 1787

(identified both as Hob. XX/1B and Hob. III/50-56 in Anthony van Hoboken's catalogue, and published as Op. 51)

- Joseph Haydn's musical work entitled 'The Seven Last Words of Christ' (numbered Hob. XX in Anthony van Hoboken's catalogue of Joseph Haydn's works) *R10 has member* Joseph Haydn's oratorio entitled 'The Seven Last Words of Christ', composed in 1796 (Hob. XX/2)

R71 specifies material part (is specified material part for)

OLD

R71 specifies material part (is specified material part for)

Domain: F3 Manifestation
Range: F3 Manifestation
Subproperty of: F3 Manifestation. R??: F3 Manifestation
Quantification: (0,n:0,n)

Scope note: This property associates an instance of F3 Manifestation which prescribes that all its physical exemplars will contain, as a separable part, an exemplar of the associated instance of F3 Manifestation. This property is transitive. In the case that the F3 Manifestation is intended to be used and distributed in digital form on a physical carrier, the property describes the physical carrier on which it can be obtained. In the case that the F3 Manifestation is an abstraction of a singleton item, the property describes the actual physical form the F3 Manifestation was abstracted from.

This inference is an induction along the path that can be modelled as: F3 Manifestation (the whole). R7i is materialized in: F5 Item. P46 is composed of: F5 Item. R7 is materialization of: F3 Manifestation (the part).

Examples:
- The publication product identified by ISBN '0618260587' and consisting of a 3-volume edition of J.R.R. Tolkien's 'The Lord of the rings' (F3) R71 specifies material part the publication product identified by ISBN '0618260595' and consisting of an edition of J.R.R Tolkien's 'The two towers' (F3)
- The publication product issued by Deutsche Grammophon in 1998 and consisting of a recording of Richard Wagner's 'Der fliegende Holländer' as performed in 1991 by Plácido Domingo, Cheryl Studer et al., and conducted by Giuseppe Sinopoli (F3) R71 specifies material part the publication product consisting of printed programme notes and libretto with French and English translations (F3)

NEW

R71 specifies material part (is specified material part for)

Domain: F3 Manifestation
Range: F3 Manifestation
Subproperty of: F3 Manifestation. R??: F3 Manifestation
Quantification: (0,n:0,n)

Scope note: This property links an instance of F3 Manifestation which prescribes that all its physical exemplars will contain, as a separable part, to an exemplar of the associated instance of F3 Manifestation. This property is transitive.

Examples:
- The publication product identified by ISBN '0618260587' and consisting of a 3-volume edition of J.R.R. Tolkien's 'The Lord of the rings' (F3) *R71 specifies material part* the publication product identified by ISBN '0618260595' and consisting of an edition of J.R.R Tolkien's 'The two towers' (F3)
- The publication product issued by Deutsche Grammophon in 1998 and consisting of a recording of Richard Wagner's 'Der fliegende Holländer' as performed in 1991 by Plácido Domingo, Cheryl Studer et al., and conducted by Giuseppe Sinopoli (F3) *R71 specifies*

material part the publication product consisting of printed programme notes and libretto with French and English translations (F3)

- The publication product issued as a 2-CD set identified as 'M2K 42270' by CBS Records in 1987 and consisting of recordings of J. S. Bach's concertos for keyboard/clavier and strings performed by Glenn Gould (F3) *R71 specifies material part* the CD identified as 'DIDC 10370' consisting of the Glenn Gould recordings of Bach's Concertos nos. 1-4 (F3)

ISSUE 459: Modelling Principles.

The document stands as it was edited during the 46th CIDOC CRM sig meeting. The figures are not updated.

Modelling principles

The following modelling principles have guided and informed the development of the CIDOC CRM.

Reality, Knowledge Bases and CIDOC CRM

The CIDOC CRM is a formal ontology in the sense introduced by N.Guarino. that is a specific vocabulary used to describe a part of reality, plus a first-order logical theory narrowing down the intended meaning of the vocabulary words (N.Guarino 1998). The syntax and formal semantics of this first-order theory are given in (Meghini & Doerr 2018), where the computational aspects are also discussed. The present document is intended for a non-technical audience, therefore it focuses on the informal semantics and on the pragmatics of the CIDOC CRM vocabulary, offering a detailed discussion of the main traits of the conceptualization underlying the CIDOC CRM through the basic usage patterns.The CIDOC CRM aims to assist sharing, connecting and integrating information from research about the past. In order to understand the function of a formal ontology of this kind, one needs to make the following distinctions:

a) The *material reality*. For the purpose of the CIDOC CRM, material reality is regarded as whatever has substance that can be perceived with senses or instruments. Examples are people, a forest or a settlement environment, sea, atmosphere, distant celestial or cellular micro structures, including what we assume could be potentially or theoretically perceived if we could be there, such as the center of Earth or the sun, and all that is past. It is constrained to space and time. What goes on in *our minds* or is produced by our minds is also regarded as part of the material reality, as it becomes materially evident to other people at least by our utterances, behavior and products.

b) The units of description or *particulars*, i.e., the things and relations which we refer to in order to distinguish parts of reality. Examples are Mount Ida, the Taj Mahal, the formation of China by emperor Qin Shi Huang (秦始皇) in 221BC, Tut-Ankh Amun and his embalming, Prince Shotoku of Japan sending a mission to China in 607AD, the participation of Socrates in the Battle of Potidaea or the radiocarbon dating of the Iceman Ötzi[1].

A formal ontology, such as the CIDOC CRM, constitutes a controlled language for talking about particulars. I.e., it provides classes and properties for categorizing particulars as so-called "instances" in a way that their individuation, unity and relevant properties are as unambiguous as possible. For instance, Tut-Ankh Amun as instance of E21 Person *is* the real pharaoh from his birth to death, and not extending to his mummy, as follows from the specification of the class E21 Person and its properties in the CIDOC CRM.

For clarification, the CIDOC CRM does not take a position against or in favour of the existence of spiritual substance nor of substance not accessible by either senses or instruments, nor does it suggest a materialistic philosophy. However, for practical reasons, it relies on the priority of integrating information based on material evidence available for whatever human experience. The CIDOC CRM only commits to a unique material reality independent from the observer.

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[1]   Kutschera, Walter. "Radiocarbon dating of the Iceman Ötzi with accelerator mass spectrometry." (2002).

When we *provide descriptions* of particulars, we need to refer to them by unique names, titles or constructed identifiers, all of which are instances of E41 Appellation in the CIDOC CRM, in order the reference to be independent of the context. (In contrast, reference to particulars by pronouns or enumerations of characteristic properties, such as name and birth date, are context dependent). The appellation, and the relation between the appellation and the referred item or relationship, must not be confused with the referred item and its identity. For example, Tut-Ankh Amun the name (instance of E41 Appellation) is different from Tut-Ankh Amun the person (instance of E21 Person) and also different from the relationship between name and person (*P1 is identified by*). Instances of CIDOC CRM classes are the *real* particulars, not their names, but in descriptions, names must be used as surrogates for the real things meant. Particulars are approximate individuations, like sections, of parts of reality. In other words, the uniqueness of reality does not depend on where one draws the line between the mountain and the valley.

A CIDOC CRM-compatible *knowledge base* (KB)[2] is an instance of E73 Information Object in the CIDOC CRM. It contains (data structures that encode) formal statements representing propositions believed to be true in a reality by an observer. These statements use appellations (e.g. http://id.loc.gov/authorities/names/n79066005[3]) of ontological particulars and of CRM concepts (e.g. *P100i died in, E21 Person*). Thereby users, in their capacity of having real-world knowledge and cognition, may be able to relate these statements to the propositions they are meant to characterize, and be able to reason and research about their validity. In other words, the formal instances in a knowledge base are the *identifiers*, not the real things or phenomena. A special case is digital content: a KB in a computer system may contain statements about instances of E90 Symbolic Object and the real thing may be text residing within the same KB. The instance of E90 Symbolic Object and its textual representation are separate entities and they can be connected with the property *P190 has symbolic content.*

Therefore, a knowledge base does not contain knowledge, but *statements that represent* knowledge, as long as there exist people that can resolve the identifiers used to their referents. (Appellations described in a knowledge base, and not used as primary substitutes of other items, are of course explicitly declared as instances of E41 Appellation in the knowledge base.)

Authorship of Knowledge Base Contents

This section describes a recommended good practice how to relate authority to knowledge base contents.

Statements in a KB must have been inserted by some human agent, either directly or indirectly. However, these statements often make no reference to that agent, lacking attribution of authority. An example of such statements in the CIDOC CRM is information expressed through shortcuts such as 'P2 has type'. In the domain of cultural heritage, it is common practice that the responsibility for maintaining knowledge in the KB is elaborated in institutional policy or protocol documents. Thus, it is reasonable to hold that statements which lack explicit authority attribution can be read as the official view of the administrating institution of that system, i.e. the maintainers of the KB. This does not imply that the knowledge described in the KB is complete. So long as the information is under active management it remains continuously open to revision and improvement as further research reveals further understandings. Statements in a KB may be in contradiction to the ontologically defined quantification of properties without the KB being broken or invalid in any sense, either because necessary properties are unknown or there exist good reasons to assume alternative values for properties with limited cardinality, be it by the same or by different maintainers. A KB does not represent a slice of reality, but the justified beliefs of its maintainers about that reality. **For simplicity** we speak about a KB as representing *some* reality.

Statements in a KB may also carry explicit references to agents that produced them, i.e. further statements of responsibility. In CIDOC CRM such statements of responsibility are expressed though knowledge creation events such as E13 Attribute Assignment and its relevant subclasses. Any knowledge that is based on an explicit creation event, where the creator's identity has been given, is attributed to the authority and assigned to the responsibility of the agent identified as causal in that event.

In the special case of an institution taking over stewardship of a database transferred into their custody, two

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[2] Carlo Meghini, Martin Doerr, 2018. *A first-order logic expression of the CIDOC*

conceptual reference model. In: *Int. J. Metadata, Semantics and Ontologies, Vol. 13, No. 2, 2018*

[3]   The URI (instance of E41 Appellation) of the Library of Congress for Tut-Ankh-Amun, the pharaoh.

relations of responsibility for the knowledge therein can be envisioned. If the institution accepts the dataset and undertakes to maintain and update it, then they take on responsibility for that information and become the default authority behind its statements as described above. If, on the other hand, the institution accepts the data set and stores it without change as a closed resource, then it can be considered that the default authority remains the original steward like for any other scholarly document kept by the institution.

Extensions of CIDOC CRM

Since the intended scope of the CIDOC CRM is a subset of the "real" world and is therefore potentially infinite, the model has been designed to be extensible through the linkage of compatible external type hierarchies.

Of necessity, some concepts covered by the CIDOC CRM are defined in less details than others: E39 Actor and E30 Right, for example. This is a natural consequence of staying within the model's clearly articulated practical scope in an intrinsically unlimited domain of discourse. These 'underdeveloped' concepts can be considered as candidate superclasses for compatible extensions, in particular for disciplines with a respective focus. Additions to the model are known as extensions while the main model is known as CRMsbase.

Compatibility of extensions with the CRM means that data structured according to an extension must also remain valid as instances of CIDOC CRM base classes. In practical terms, this implies query containment: any queries based on CIDOC CRM concepts to a KB should retrieve a result set that is correct according to the model's semantics, regardless of whether the KR is structured according to the CIDOC CRM's semantics alone, or according to the CIDOC CRM plus compatible extensions. For example, a query such as "list all events" should recall 100% of the instances deemed to be events by the CIDOC CRM, regardless of how they are classified by the extension.

A sufficient condition for the compatibility of an extension with the CIDOC CRM is that its classes, other than E1 CRM Entity, subsume all classes of the extension, and all properties of the extension are either subsumed by CRM properties, or are part of a path for which a CIDOC CRM property is a shortcut, and that classes and properties of the extension can be well distinguished from those in the CIDOC CRM. For instance, a class "tangible object" may be in conflict with existing classes of the CIDOC CRM. Obviously, such a condition can only be tested intellectually.

The CRM provides a number of mechanisms to ensure that coverage of the intended scope can be increased on demand without loosing compatibility:

1) Existing classes can be extended, either structurally as subclasses or dynamically using the type hierarchy (see section About Types below).

2) Existing properties can be extended, either structurally as subproperties, or in some cases, dynamically, using properties of properties which allow subtyping (see section About Types below).

3) Additional information that falls outside the semantics formally defined by the CIDOC CRM can be recorded as unstructured data using E1 CRM Entity. P3 has note: E62 String.

4) Extending the CIDOC CRM by superclasses and properties that pertain to a wider scope. They are called conservative extensions, if they preserve backwards compatibility with instances described with the CIDOC CRM.

Following strategies 1, 2 and 3 will have the result that the CIDOC CRM concepts subsume and thereby cover the extensions. This means that querying an extended knowledge base only with concepts of the CIDOC CRM will nevertheless retrieve all facts described via the extensions.

In mechanism 3, the information in the notes is accessible in the respective knowledge base by retrieving the instances of E1 CRM Entity that are domain of *P3 has note*. Keyword search will also work for the content of the note. Rules should be applied to attach a note to the item most specific for the content. For instance, details about the role of an actor in an activity should be associated with the instance of E7 Activity, and not with the instance of E39 Actor. This approach is preferable when queries relating elements from the content of such notes across the knowledge base are not expected.

In general, only concepts to be used for selecting multiple instances from the knowledge base by formal querying

need to be explicitly modelled. This criterion depends on the expected scope and use of the particular knowledge base. <mark>The CIDOC CRM models with priority the kinds of facts one would like to retrieve and relate from across heterogeneous content from different institutions, in contrast, for instance, to administrative practices internal to an institution.</mark>

Mechanism 4, conservative extension, is more complex:

With increasing use of the CIDOC CRM, there is also a need for extensions that model phenomena from a scope wider than the original one of the CIDOC CRM, but which are also applicable to the concepts that do fall within the CIDOC CRM's scope. When this occurs, properties of the CIDOC CRM may be found to be applicable more generally to superclasses of the extension than to those of their current domain or range in the CIDOC CRM. This is a consequence of the key principle of the CIDOC CRM to model "bottom up", i.e., selecting the domains and ranges for properties to be as narrow as they would apply in a well understood fashion in the current scope, thus avoiding making poorly understood generalizations at risk of requiring non-monotonic correction.

The fourth mechanism for extending the CIDOC CRM by conservation extension can be seen to be split into two cases:

1) A new class or property is added to an extension of the CIDOC CRM, which is not covered by superclasses other than E1 CRM Entity or a superproperty in the CIDOC CRM respectively. In this case, all facts described only by such concepts are *not* accessible by queries with CIDOC CRM concepts. Therefore, the extension should *publish* in a compatibility statement the additional relevant high-level classes and properties needed to retrieve all facts documented with the extended model. This case is a monotonic extension.

2) The domain or range of an existing property in the CIDOC CRM is changed to a superclass of the one or the other or both, because the property is understood to be applicable beyond its originally anticipated scope. In this case, all facts described by the extension are still accessible by querying with the concepts of the CIDOC CRM, but the extension can describe additional facts that the CIDOC CRM could not. This case is a monotonic extension and generally recommended, because it enables bottom-up evolution of the model. If this change is part of a new release of the CIDOC CRM itself, it is simply backwards compatible, and this has been done frequently in the evolution of this model.

If case (2) should be documented and implemented in an extension module separate from the CIDOC CRM, it may come in conflict with the current way knowledge representation languages, such as RDF/OWL, treat it, because in formal logic changing the range or domain of a property is regarded as changing the ontological meaning completely; there is no distinction between the meaning of the property independent of domain and range and the specification of the domain and range. It is, however, similar to what in logic is called a conservative extension of a theory, and necessary for an effective modular management of ontologies.

Therefore, for the interested reader, we describe here a definition of this case in terms of first order logic, which shows how modularity can formally be achieved:

Let us assume a property P defined with domain class A and range class C also holds for a domain class B, superclass of A, and a range class D, superclass of C, in the sense of its ontological meaning in the real world. We describe this situation by introducing an auxiliary formal property P', defined with domain class B and range class D, and apply the following logic:

$$A(x) \supset B(x)$$
$$C(x) \supset D(x)$$
$$P(x,y) \supset A(x)$$
$$P(x,y) \supset C(y)$$
$$P'(x,y) \supset B(x)$$
$$P'(x,y) \supset D(y)$$

Then, P' is a conservative extension of P if: $A(x) \wedge C(y) \wedge P'(x,y) \equiv P(x,y)$

In other words, a separate extension module may re-declare the respective property with another identifier, preferably using the same label, and implement the above rule.

Minimality

Although the scope of the CIDOC CRM is very broad, the model itself is constructed as economically as possible.

- CIDOC CRM classes and properties are either primitive, or they are key concepts in the practical scope.
- Complements of CIDOC CRM classes are not declared, because, considering the Open World principle, there are no properties for complements of a class (see Terminology and first consequence

of Monotonicity).

A CIDOC CRM class is declared when:
- It is required as the domain or range of a property not appropriate to its superclass.
- It serves as a merging point of two CIDOC CRM class branches via multiple IsA (e.g. E25 Human-Made Feature). When the branch superclasses are used for multiple instantiation of an item, this item is in the intersection of the scopes. The class resulting from multiple IsA should be narrower in scope than the intersection of the scopes of the branch superclasses.
- It is useful as a leaf class (i.e. at the end of a CIDOC CRM branch) to domain communities building CIDOC CRM extensions or matching key domain classes from other models to the CIDOC CRM (e.g. E34 Inscription).

Shortcuts

Some properties are declared as shortcuts of longer, more comprehensively articulated paths that connect the same domain and range classes as the shortcut property via one or more intermediate classes. For example, the property *E18 Physical Thing. P52 has current owner (is current owner of): E39 Actor*, is a shortcut for a fully articulated path from E18 Physical Thing through E8 Acquisition to E39 Actor. An instance of the fully-articulated path always implies an instance of the shortcut property. However, the inverse may not be true; an instance of the fully-articulated path cannot always be inferred from an instance of the shortcut property inside the frame of the actual KB

The class E13 Attribute Assignment allows for the documentation of how the assignment of any property came about, and whose opinion it was, even in cases of properties not explicitly characterized as "shortcuts".

Monotonicity

The CIDOC CRM's primary function is to support the meaningful integration of information in an Open World. The adoption of the Open World principle means that the CIDOC CRM itself must remain fundamentally open and knowledge bases implemented using it should be flexible enough to receive new insights. At the model level, new classes and properties within the CIDOC CRM's scope may be found at any time in the course of integrating more documentation records or when new kinds of relevant facts come to the attention of its maintainers. At the level of the KBs, the need to add or revise information may arise due to numerous external factors. Research may open new questions; documentation may be directed to new or different phenomena; natural or social evolution may reveal new objects of study.

It is the aim of the maintainers of the CIDOC CRM to respect the Open World principle and to follow the principle of monotonicity. Monotonicity requires that adding new classes and properties to the model or adding new statements to a knowledge base does not invalidate already modelled structures and existing statements.
A first consequence of this commitment, at the level of the model, is that the CIDOC CRM aims to be monotonic in the sense of Domain Theory. That is to say, the existing CIDOC CRM constructs and the deductions made from them should remain valid and well-formed, even as new constructs are added by extensions to the CIDOC CRM. Any extensions should be, under this method, backwards compatible with previous models. The only exception to this rule arises when a previous construct is considered objectively incorrect by the domain experts and thus subjected to corrective revision. Adopting the principle of monotonicity has active consequences for the basic manner in which classes and properties are designed and declared in the CIDOC CRM. In particular, it forbids the declaration of complement classes, i.e. classes solely defined by excluding instances of some other classes.

For example:
FRBRoo extends the CIDOC CRM. In version 2.4 of FRBRoo, F51 Name Use Activity was declared as a subclass to the CIDOC CRM class E7 Activity. This class was added in order to describe a phenomenon specific to library practice and not considered within CRM base. F51 Name Use Activity describes the practice of an instance of E74 Group adopting and deploying a name within a context for a time-span. The creation of this extension is monotonic because no existing IsA relationship or inheritance of properties in CRM base are compromised and no future extension is ruled out. By way of contrast, if, to handle this situation, a subclass "Other Activity" had been declared, a non-monotonic change would have been introduced. This would be the case because the scope note of a complement class like "Other Activities" would forbid any future declaration of specializations of E7 Activity such as 'Name Use Activity'. In the case the need arose to declare a particular specialized subclass, a non-monotonic revision would have to be made, since there would be no principled way to decide which instances of 'Other Activity' were instances of the new, specialized class and which were not. Such non-monotonic changes are extremely costly to end users, compromising backwards compatibility and long term integration.

As a second consequence, maintaining monotonicity is also required during revising or augmenting data within a CIDOC CRM compatible system. That is, existing CIDOC CRM instances, their properties and the deductions made from them, should always remain valid and well-formed, even as new instances, regarded as consistent by the domain expert, are added to the system.

For example:
If someone describes correctly that an item is an instance of E19 Physical Object, and later it is correctly characterized as an instance of E20 Biological Object, the system should not stop treating it as an instance of E19 Physical Object. This is achieved by declaring E20 Biological Object as subclass of E19 Physical Object.

This example further demonstrates that the IsA hierarchy of classes and properties can represent characteristic stages of increasing knowledge about some item during the processes of investigation and collection of evidence. Higher level classes can be used to safely classify objects whose precise characteristics are not known in the first instance. An ambiguous biological object may, for example, be classified as only a physical object. Subsequent investigation can reveal its nature as a biological object. A knowledge base constructed with CIDOC CRM classes designed to support monotonic revision allows for seeking physical objects that were not yet recognized as biological ones. This ability to integrate information with different specificity of description in a well-defined way is particularly important for large-scale information integration. Such a system supports scholars being able to integrate all information about potentially relevant phenomena into the information system without forcing an over or under commitment to knowledge about the object. Since large scale information integration always deals with different levels of knowledge of its relevant objects, this feature enables a consistent approach to data integration.

A third consequence, applied at the level of the knowledge base, is that in order to formally preserve monotonicity, when it is required to record and store alternative opinions regarding phenomena all formally defined properties should be implemented as unconstrained (many: many) so that conflicting instances of properties are merely accumulated. Thus, integrated knowledge can serve as a research tool for accumulating relevant alternative opinions around well-defined entities, whereas conclusions about the truth are the task of open-ended scientific or scholarly hypothesis building.

For example:
King Arthur's basic life events are highly contested. Once entered in a knowledge base, he should be defined as an instance of E21 Person and treated as having existed as such within the sense of our historical discourse. The instance of E21 Person is used as the collection point for describing possible properties and existence of this individual. Alternative opinions about properties, such as the birthplace and his living places, should be accumulated without validity decisions being made during data compilation. King Arthur may be entered as a different instance, of E28 Conceptual Object, for describing him as mythological character and accumulating possibly mythological facts.

The fourth consequence of monotonicity relates to the use of time dependent properties in a knowledge base. Certain properties declared in the CIDOC CRM, such as having a part, an owner or a location, may change many times for a single item during the course of its existence. Asserting that such a property holds for some item means that that property held for some particular, undetermined time-span within the course of its existence. Consequently, one item may be the subject of multiple statements asserting the instantiation of that property without conflict or need for revision. The collection of such statements would reflect an aggregation of these instances of this property holding over the time-span of the item's existence. If a more specific temporal knowledge is required/available, it is recommended to explicitly describe the events leading to the assertion of that property for that item. For example, in the case of acquiring or losing an item, it would be appropriate to declare the related event class such as E9 Move. By virtue of this principle, the CRM achieves monotonicity with respect to an increase of knowledge about the states of an item at different times, regardless of their temporal order.

Time-neutral properties may be specialized in a future monotonic extension by time-specific properties, but not vice-versa. Also, many properties registered do not change over time or are relative to events in the model already. Therefore, the CIDOC CRM always gives priority to modelling properties as time-neutral, and rather representing changes by events.

However, for some of these properties many databases may describe a "current" state relative to some property, such as "current location" or "current owner". Using such a "current" state means that the database manager is

able to verify the respective reality at the latest date of validity of the database. Obviously, this information is non-monotonic, i.e., it requires deletion when the state changes. In order to preserve a reduced monotonicity, these properties have time-neutral superproperties by which respective instances can be reclassified if the validity becomes unknown or no longer holds. Therefore, the use of such properties in the CRM is only recommended if they can be maintained consistently. Otherwise, they should be reclassified by their time-neutral superproperties. This holds in particular if data is exported to another repository, see also the paragraph "AuthorityAuthorship of Knowledge Base Contents"

Disjointness

Classes are disjoint if they cannot share any common instances at any time, past, present or future. That implies that it is not possible to instantiate an item using a combination of classes that are mutually disjoint or with subclasses of them (see "multiple instantiation" in section "Terminology"). There are many examples of disjoint classes in the CIDOC CRM.

A comprehensive declaration of all possible disjoint class combinations afforded by the CIDOC CRM has not been provided here; it would be of questionable practical utility, and may easily become inconsistent with the goal of providing a concise definition. However, there are two key examples of disjoint class pairs that are fundamental to effective comprehension of the CIDOC CRM:

- **E2 Temporal Entity is disjoint from E77 Persistent Item.** Instances of the class E2 Temporal Entity are perdurants, whereas instances of the class E77 Persistent Item are endurants. Even though instances of E77 Persistent Item have a limited existence in time, they are fundamentally different in nature from instances of E2 Temporal Entity, because they preserve their identity between events. Declaring endurants and perdurants as disjoint classes is consistent with the distinctions made in data structures that fall within the CIDOC CRM's practical scope.
- **E18 Physical Thing is disjoint from E28 Conceptual Object.** The distinction is between material and immaterial items, the latter being exclusively human-made. Instances of E18 Physical Thing and E28 Conceptual Object differ in many fundamental ways; for example, the production of instances of E18 Physical Thing implies the incorporation of physical material, whereas the production of instances of E28 Conceptual Object does not. Similarly, instances of E18 Physical Thing cease to exist when destroyed, whereas an instance of E28 Conceptual Object perishes when it is forgotten or its last physical carrier is destroyed.

Transitivity

CIDOC CRM is formulated as a class system with inheritance. A property P with domain A and range B will also be a property between any possible subclasses of A and of B. In many cases there will be a common subclass C of both A and B. In these cases, when the property is restricted to C, that is, with C as domain and range, the restricted property could be transitive. For instance, an E73 Information Object can be incorporated into a E90 Symbolic Object and thus an information object can be incorporated in another information object.
In the definition of CIDOC CRM the transitive properties are explicitly marked as such in the scope notes. All unmarked properties should be considered as not transitive.

• *Introduction to the basic concepts*

The following paragraphs explain the most general logic of the CIDOC CRM. The CIDOC CRM is a formalized representation of historical discourse, a formal ontology. In this capacity, it is meant to support the (re)presentation of fact based, analytic discourse about what has happened in the past in a human understandable and machine-processable manner. It achieves this function by proposing a series of formalized properties (relations) and classes. The formalized properties support the making of semantically explicit statements relating classes of things. Their formal definition logically explicates the classes of things to which they may pertain. The CIDOC CRM properties thus enable a formal, logically explicit description of relations between individual, real world items, classified under distinct ontological classes. Encoding analytic data pertaining to the past under such a system of statements provides a standard representation for data and allows the uniform application of reasoning to large sets of data.

Grounding this high level logic is a hierarchical system of classes and relations, that provide basic ontological distinctions by which to represent historical discourse. Familiarity with the basic ontological distinctions made in

the top level of the class hierarchy provides the basic entry point to understanding how to apply the CIDOC CRM for knowledge representation.

The highest level distinction in the CIDOC CRM is represented by the top level concepts of E77 Persistent Item, equivalent to the philosophical notion of endurant; E2 Temporal Entity, equivalent to the philosophical notion of perdurant and, further, the concept of E92 Spacetime Volume.

As an event-centric model, supporting historical discourse, the CIDOC CRM firstly enables the description of entities that are themselves time-limited processes or evolutions within the passing of time using E2 Temporal Entity and its subclasses. Their basic function is to capture the fact of something having happened over time. In addition to allowing the description of a temporal duration, the subclasses of E2 Temporal Entity are used to document the historical relations between objects, similar to the role of action verbs in a natural language phrase. The more specific subclasses of E2 Temporal Entity enable the documentation of events pertaining to individually related/affected material, social or mental objects that have been described using subclasses of E77 Persistent Item. This precise documentation is enabled through the use of specialized properties formalizing the manner of the relation or affect. Examples of specific subclasses of E2 Temporal Entity include E12 Production, which allows the representation of events of making things by humans, and E5 Event which allows the documentation, among other things, of geological events and large scale social events such as a war. Each of these subclasses have specific properties associated to them which allow them to function to represent the specific, real world connection between instances of E77 Persistent Item, such as the relation of an object to its time of production through *p108 was produced by* (E12) or the relation of a place to a geological phenomenon through *p7 was place of* (E5). The entities that E2 Temporal Entity documents, being time limited processes / occurrences, are such that their existence can be declared only on the basis of direct observation or recording of the event, or indirect observation of its material outcomes. Evidence of such entities may be preserved on material objects that are permanently changed because of them. Likewise events may have been recorded in text or remembered through oral history. E2 Temporal Entity and its subclasses are central to the CRM and essential for almost all modelling tasks (e.g. in a museum catalogue one cannot consider an object outside its production event).

The real world entities, which the event centric modelling of the CIDOC CRM aims to enable the accurate historical description of, are captured through E77 Persistent Item and its subclasses. E77 Persistent Item is used to describe entities that are relatively stable in form through the passage of time, maintaining a recognizable identity because their significant properties do not change. Specific subclasses of E77 Persistent Item can illustrate this point. E22 Human Made Object is used for the description of discrete, physical objects having been produced by human action, such as an artwork or monument. An artwork or monument is persistent with regards to its physical constitution. So long as it retains its general physical form it is said to exist and to participate in the flow of historical events. E28 Conceptual Object is also used to describe persistent items but of a mental character. It is used to describe identifiable ideas that are named and form an object of historical discourse. Its identity conditions rely in having a carrier by which it can be recalled. The entities described by E77 Persistent Item are prone to change through human activity, biological, geological or environmental processes, but are regarded to continue to exist and be the same just as long as such changes do not alter their basic identity (essence) as defined in the scope note of the relevant class.

The notion of identity is key in the application of CIDOC CRM. The properties and relations it provides are designed to allow the accurate historical description of the evolution of real world items through time. This being the case, classes and properties are created in order to provide a definition which will allow the accurate application of the classes or properties to the same real world items by diverse users. Identity in the sense of the CIDOC CRM, therefore, means that informed people are able to agree that they refer to the same, single thing, according to the scope note of the respective CIDOC CRM class it is regarded to be an instance of. For example, the Great Sphinx of Giza may have lost part of its nose, but there is no question that we are still referring to the same monument as that before the damage occurred, since it continues to represent significant characteristics and distinctness from an overall shaping in the past, which is of archaeological relevance. Things lacking sufficient stability or differentiation, such as atmosphere, soil, clouds, waves, are not instances of E77 Persistent Item, and not suited for information integration. Discourse about such items may be documented with concepts of the CIDOC CRM as observations in relation to things of persistent identity, such as places.

Learning to distinguish and then interrelate instances of E77 Persistent Item (endurants) and instances of E2 Temporal Entity (perdurants) using the appropriate properties is key to the proper understanding and application of CIDOC CRM in order to formally represent analytic historical data. In the large majority of cases, the distinction this provides and the subsequent elaboration of subclasses and properties is adequate to describe the content of database records in the cultural and scientific heritage domain. In exceptional cases, where we need to

consider complex combinations of changes of spatial extent over time, the concept of spacetime (E92 Spacetime Volume) also needs to be considered. E92 Spacetime Volume describes the entities whose substance has or is an identifiable, confined geometrical extent in the material world that may vary over time, fuzzy boundaries notwithstanding. For example, the built settlement structure of the city of Athens is confined both from the point of view of time-span (from its founding until now) and from its changing geographical extent over the centuries, which may become more or less evident from current observation, historical documents and excavations. Even though E92 Spacetime Volume is an important theoretical part of the model, it can be ignored for most practical documentation and modeling tasks.

The key to the proper understanding of CIDOC CRM comes through the appropriation of its basic divisions and the logic these represent. It is important to underline that the CIDOC CRM is not intended to function as a classification system or vocabulary tool. The basic class divisions in CIDOC CRM are declared in order to be able to apply distinct properties to these classes and, in so doing, formulate precise, analytic propositions that represent historical realities The expressive power of CIDOC CRM comes not from the application of classes to classify entities but in the documenting the interrelation of individual historical items through well defined properties. These properties characteristically cover subjects such as relations of *identifying* items by names and identifiers; *participation* of persistent items in temporal entities; *location* of temporal entities and physical things in space and time; relations of *observation* and assessment; part-decomposition and *structural* properties of anything; *influence* of things and experiences on the activities of people and their products; *reference* of information objects to anything.

We explain these concepts with the help of graphical representations in the next sections.

Relations with Events:

Figure 1 illustrates the minimal properties in the CIDOC CRM for documenting "what has happened", the central pattern of the Model. Let us first consider the class *E1 CRM Entity*, the formal top class of the model. It primarily serves a technical purpose to aggregate the ontologically meaningful concepts of the model. It declares however two important properties of general validity and distinct features of the Model: *P1 is identified by*, with range *E41 Appellation,* makes the fundamental ontological distinction between the identity of a particular and an identifier (see section "Reality and Knowledge Bases" above), and in practice allows for describing a discourse about resolving historical ambiguities of names and reconciliation of multiple identifiers. The property *P2 has type*, with range *E55 Type*, constitutes a practical interface for refining classes by terminologies, being often volatile, as detailed in the section "About Types" below.
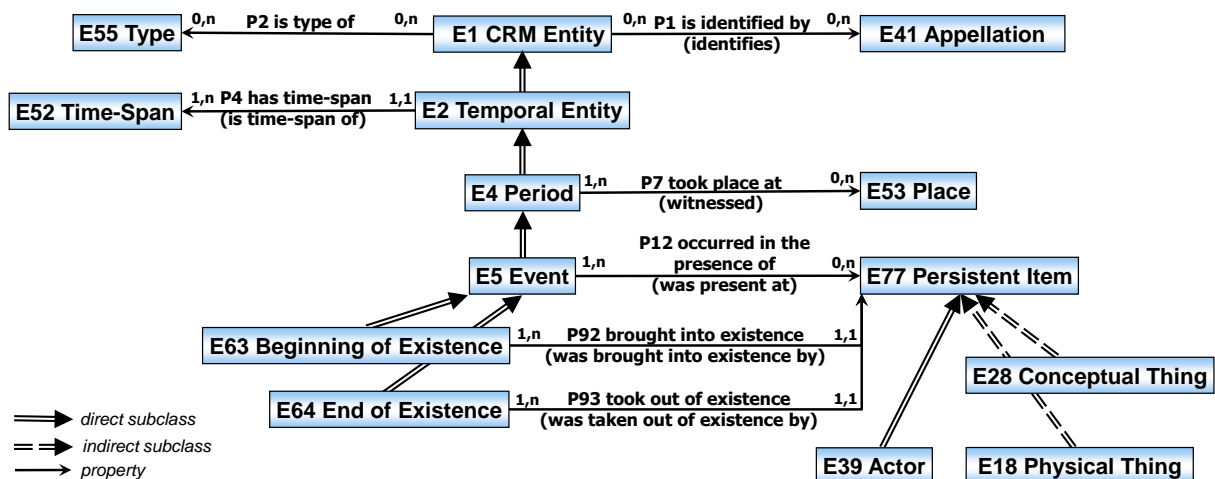

figure 1: properties of basic concepts

All classes in figure 1 are direct or indirect subclasses of *E1 CRM Entity,* but for better readability, only the "subclass of" -link from *E2 Temporal Entity* is shown. The latter comprises phenomena that continuously occur over some time-span (*E52 Time-Span*) in the natural time dimension, but some of them may not be confined to

specific area, such as a marriage status[4]. Further specializing, *E4 Period* comprises phenomena occurring in addition within a specific area in the physical space, which can be specified by *P7 took place at*, with range *E53 Place*. Instances of *E4 Period* can be of any size, such as the Warring States Period, the Roman Period, a siege or just the process of making a signature. Further specializing, *E5 Event* comprises phenomena involving and affecting certain instances of *E77 Persistent Item* in a way characteristic of the kind of process, which can be specified by the property *P12 occurred in the presence of.* This concept of presence is very powerful: It constrains the existence of the involved things to the respective places within the specified time and implies the potential of passive or active involvement and mutual impact. Via presence, events represent nodes in a network of **things meeting** in various combinations in the course of time at different places.

The most important specializations of *E77 Persistent Item* in this context are: *E39 Actor*, those capable of intentional actions, *E18 Physical Thing*, having an identity bound to a relative stability of material form, and *E28 Conceptual Object,* the idealized things that can be recognized but have an identity independent from the materialization on a specific carrier. The property *P12 occurred in the presence of* has 36 direct and indirect subproperties, relating these and many more subclasses of *E5 Event* and *E77 Persistent Item.* Regardless whether a CRM-compatible knowledge base is created with these properties only or with their much more expressive specializations, querying for the above presented five properties will provide answer to all "Who-When-Where-What-How" questions, and allow for retrieving potentially richly elaborated stories of people, places, times and things.

This pattern of "meeting" is complemented by two more subclasses of *E5 Event*: *E63 Beginning of Existence* and *E64 End of Existence*, which imply not only presence, but constitute the **endpoints of existence** of things and people in space and time, often in explicit presence and interaction with others, be they causal by producing or consuming or just witnessing, Note that the Model supports multiple instantiation. As a consequence particular events can be instances of combinations of these and others classes, describing tightly integrated processes of multiple nature. The representation of things connected in events by presence, beginning and end of existence is sufficient to describe the logic of *termini postquos and antequos*, a major form of reasoning about chronology in historical studies.

Example:

As a simple, real example of applying the above concepts we present a historical event, relevant for the history of art: Johann-Joachim Winkelmann (a German Scholar) has seen the so-called Laocoön Group in 1755 in the Vatican in Rome (at display in the Cortile del Belvedere). He described his impressions in 1764 in his "History of the Art of Antiquity", (being the first to articulate the difference between Greek, Greco-Roman and Roman art, characterizing Greek art with the famous words "…noble simplicity, silent grandeur"). The sculpture, in Hellenistic "Pergamene baroque" style, is widely assumed to be a copy, made between 27 BC and 68 AD (following a Roman commission) from a Greek (no more extent) original. Johann-Joachim Winkelmann was born 1717 as child of Martin Winkelmann and Anna-Maria Meyer and died in 1768 in Trieste.

Figure 2 presents a semantic graph of this event, as described above, using CIDOC CRM concepts. The facts in parentheses above are omitted for better clarity. Instances of classes are represented by informative labels instead of identifiers, in boxes showing the class label above the instance label. Properties are represented as arrows with the property label attached. After class labels and property labels we show in parenthesis the identifiers of the respective superclasses and superproperties from figure 1, in order to demonstrate that the story can be represented and queried with these concepts only. It also shows how concept specialization increases expressiveness without losing genericity. It is noteworthy that the transfer of information from the Greek original, to the copy, to the mind of Winkelmann and into his writings can be understood solely by this chain of things *being present* in different meetings. Note also that the degree to which a fact is believed to be real does not affect the choice of CIDOC CRM concepts for description of the fact, nor the reality concept underlying the Model.

Figure 2 represents in addition one more top-level property of the CIDOC CRM: *P67 refers to*, which describe an evidence-based fact that an information object makes reference to an identifiable item.
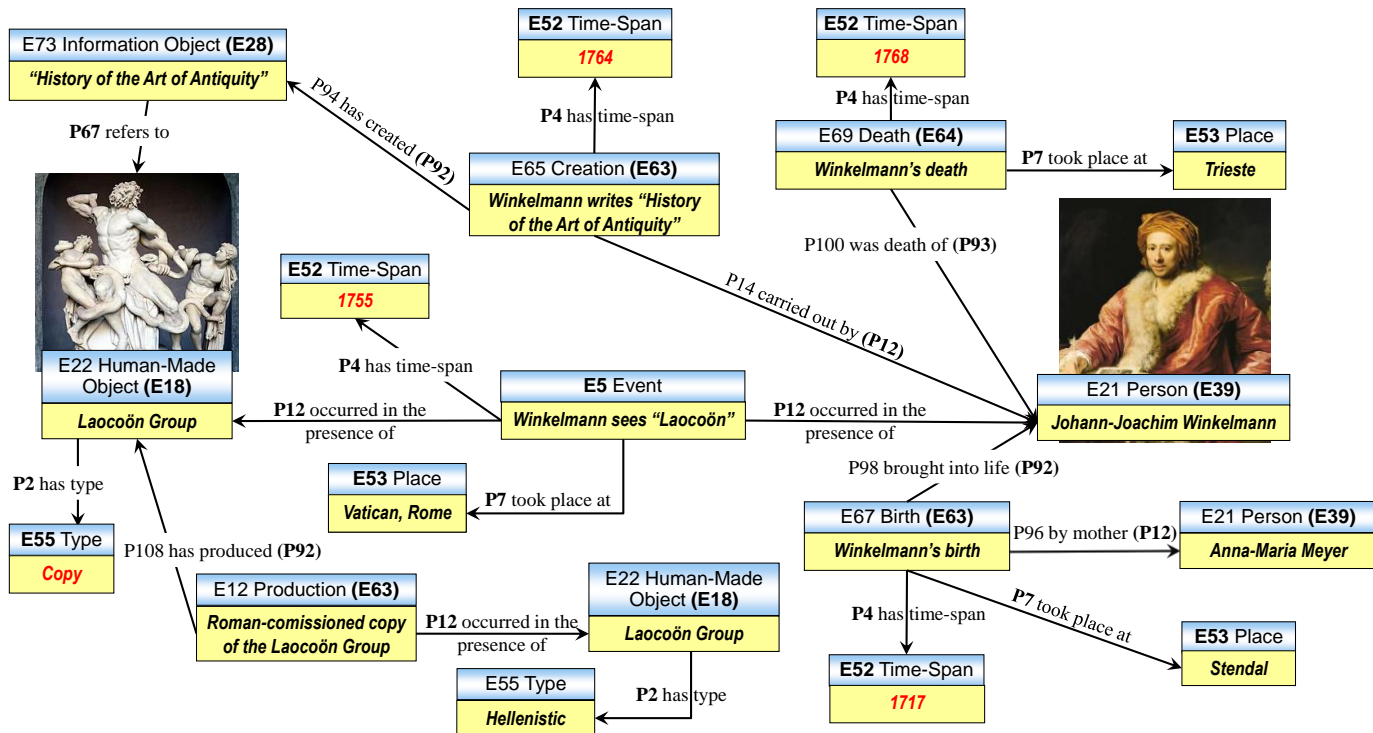
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[4]

fig. 2 CRM encoding example: Winkelmann seeing Laocoön

In the following, we give an overview of the system of spatial and temporal relations in the CIDOC CRM, because it constitutes an important tool for precise documentation of the past and has a certain complexity that needs to be understood in a synopsis.

Spatial Relations (Figure 3)

A major area of documentation and historical research centres around positioning in space of what has happened and the things involved, as well as reasoning about respective spatial relations. The key class CIDOC CRM provides for modeling this information is *E53 Place*. *E53 Place* is used to document geometric extents in the physical space containing actual or possible positions of things or happenings. The higher level properties and classes of CIDOC CRM that centre around *E53 Place* allow for the documentation of: relations between places, recording the geometric expressions defining or approximating a place and their semantic function, tracing the history of locations of a physical object, identifying the places where an individual or group have been located, identifying places on a physical object and the spatial extent of certain temporal entities.

Relations between Places: The cluster of relations *P89 falls within (contains)*, *P122 borders with*, *P121 overlaps with* and *P189 approximates* can express relative relationships held between places. These properties hold between instances of *E53 Place* and allow interordering places using common mereotopological concepts.

Geometric Expressions of Place: Contemporary documentation of spatial information has access to advanced equipment for accurately recording location and libraries of georeferenced place information. For this reason, documentation of place now often includes the recording of precise coordinates for a referenced place. Of great importance semantically, is to understand the manner in which such a geometric place expression actually relates to a referenced place. The cluster or relations *P168 place is defined by*, *P171 at some place within*, and *P172 contains* allows the user to link to geometric place expressions while also accurately indicating how this expression relates to the documented place. Geometric place expressions are instances of *E94 Space Primitive*, a primitive class for expressing values in data systems not further analyzed in the CIDOC CRM. These properties provide a valid interface to the OGC standards, as elaborated in CRMgeo (Doerr and Hiebel 2013).

History of Object Locations: Instances of place are often referenced in order to record the location of some object. When the movement of the object to different locations through time is of interest, it is also important to be able to analytically record the different locations at which an object was and at what point. The CIDOC CRM offers

two top level mechanisms for tracing the relation of objects to places. If the aspect of time is unknown or not of interest, then an object can be related to a place through the properties *P53 has former or current location* and *P55 has current location*. The former property is the conservatively appropriate choice for documenting the object-to-place relation when time elements are not known. If one is actively tracking current location, the latter property is also of use. When an accurate history of the temporal aspect of location should be provided, the user should take advantage of the *E9 Move* class, a temporal entity class. Instantiating *E9 Move* allows the user to document the origin, destination and concerned object of a move event using the collection of properties *P27 moved from*, *P26 moved to*, *P25 moved*. Being a temporal class *E9 Move* further allows the tracing of time, agency etc. Note that things may be moved indirectly as parts of or within other things.

Actor Locations: Tracking the history of the location of actors is related to the history of object location with a significant difference: in the CIDOC CRM an actor is defined as an entity featuring agency which is not the case in objects and physical entities in general. Not being physical, an actor cannot be the subject of *E9 Move* which documents physical relocations. The CIDOC CRM thus offers the notion of *P74 has current or former residence* in order to document the relation of a person or group to a location as residing there at some time.

Places on a Physical Object: In the recording of cultural heritage and other scientific data, particularly about mobile objects, including ships, it is often necessary to identify where on an object or a certain feature is located and where a certain phenomenon is observed. For this the CIDOC CRM offers the relation *P59 has section* relating the object to the places which are defined upon it. Note that Earth is the physical object we relate places to per default. In geological times, a narrower relation to a tectonic plate may be necessary.

Spatial Extent of Temporal Entities: In order to spatially define the extent of temporal phenomena, the CIDOC CRM offers two properties that apply to all instances of temporal entity under the class *E4 Period*: *P7 took place at* and *P8 took place on or within*. The former is used to relate a temporal phenomenon directly to an instance of *E53 Place* which provides the geometric context in which that phenomenon took place. The latter property allows the documentation of a temporal phenomenon taking place in relation to a physical object. This is useful for recording information such as the occurrence of an event on a moving ship or within a particular storage container, where the geometric location is not known or indirectly relevant.
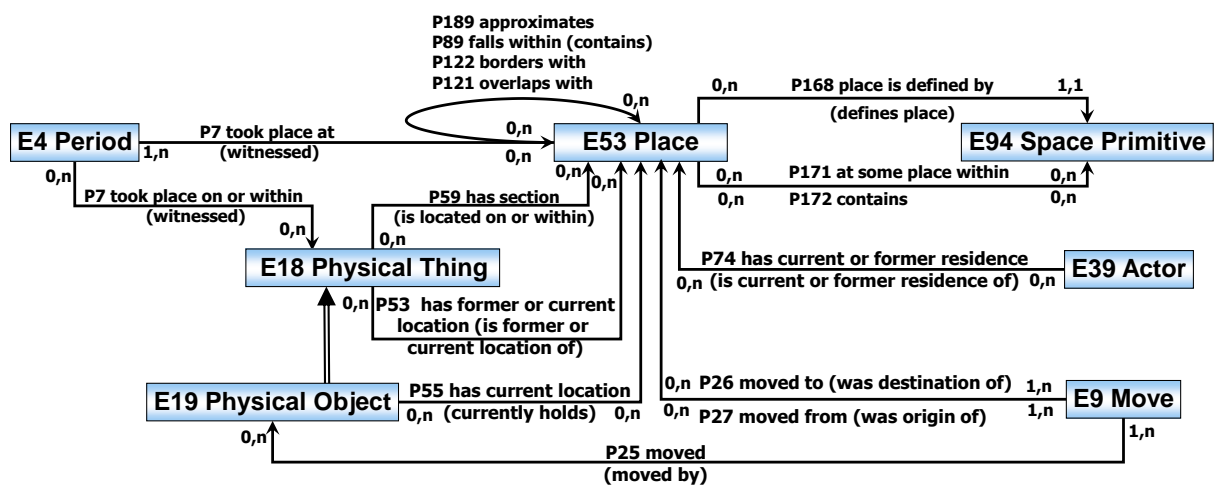

fig. 3 reasoning about spatial information

Temporal Relations (figure 4)

Historical and scientific discourse about the past deals with different levels of knowledge regarding events and their temporal ordering that feed into chronology. Chronology is fundamental to understanding social and natural history, and reasoning about temporal relations and causality is directly related. An immense wealth of physical observations allows for inferring temporal relations and vice-versa. It is important to be able to document temporality both with regards to known dates but also according to relative positioning within a historical time line. The top level properties of the CIDOC CRM relating to temporal entities support the documentation of: dates as time spans or dimensions, mereological relations between temporal entities as well as a complete suite of topological relations.

Dates and Durations: When some absolutely dates limiting a temporal entity are known, this can be documented by instantiating the *P4 has time-span* property and creating an instance of *E52 Time-span*. Dates should then be recorded as instances of *E61 Time Primitive* and related to the time-span through properties *P81 ongoing throughout* or *P82 at some time within*. Time is recorded as a span and not an instant in the CIDOC CRM. The choice of property *P81 ongoing throughout* allows the documentation of knowledge that a temporal phenomenon was occurring at least at all points of a known time span. The property *P82 at some time within* allows the weaker claim that the phenomenon must have occurred within the limits of a particular time span without further specifying as to when precisely. It is the default for historical dates, given, for instance, in years for events of much smaller duration. The actual mode of encoding the documented date is outside the scope of the CIDOC CRM, which defines this with a primitive class, *E61 Time Primitive*. Finally, the property *P191 had duration* can be deployed in order to document a temporal phenomenon with known duration but with less precisely temporal positioning. For instance, a birth may be known with the precision of a year, but with a duration of 3 hours. For documenting exact time-spans that are result of a declarations rather than observation, for instance in order to describe a time-span multiple events may fall into, the property *P170 defines time* allows for specifying the time-span uniquely by a temporal primitive, rather than by *P81 ongoing throughout* or *P82 at some time within* using an identical time primitive.
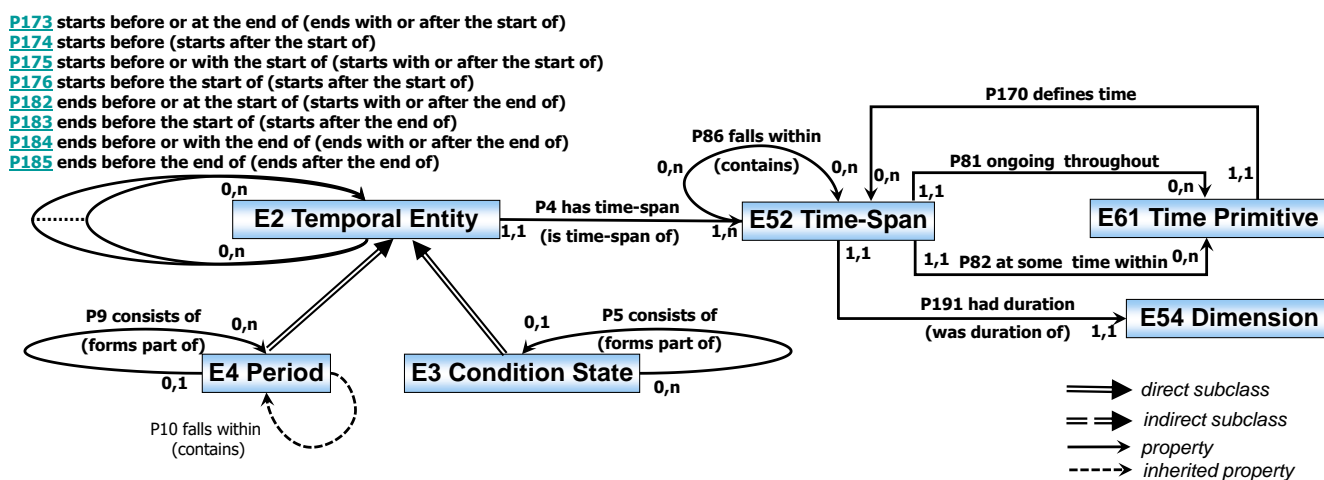

fig. 4 reasoning about temporal information

Mereological relations: The documentation of the part-whole relationship of temporal phenomena is crucial for historical reasoning. The CIDOC CRM distinguishes under temporal entities two immediate specializations: *E4 Period* is a high-level concept for the documentation of temporal phenomena of change and interactions in space and time, comprising but not limited to historical periods such as Ming or Roman, and is further specialized in rich hierarchy of more specific processes and activities. The second specialization is *E3 Condition State*, a rather specific class for the documentation of static phases of physical things. The CIDOC CRM so far does not describe a higher level class of static phases, because they are normally deductions from multiple observations, problematic in information integration and vulnerable to non-monotonic revision. For both classes, two different mereological relations are articulated: The property *P9 consists of* is used to document proper parthood between instances of *E4 Period*, i.e., to describe how the phenomena that make up an instance of *E4 Period* can causally be subdivided into more delimited phenomena. In contrast, the property *P10 falls within*, explained further in the section about spatiotemporal relations, describes only a non-causal co-occurrence in the same spatiotemporal extent. The property *P5 consists of* indicates, in analogy, proper parthood between instances of *E3 Condition State*.

Topological Relations: A lot of semantic relations have implications on the temporal ordering of temporal entities. For instance, meeting someone must occur after birth and before death of the involved parties. Information can only be transferred after it has been learned. On the other side, direct information about temporal order has implications on possible or impossible semantic relations. This form of reasoning is of paramount importance for research about the past. It turned out that the popular temporal relations defined by (J. Allen 1983), which the CIDOC CRM had adopted in previous versions, are not well suited to describe inferences from semantic relations, as detailed in the section "Temporal Relation Primitives based on fuzzy boundaries" below. Instead, the CIDOC CRM introduces a theory of fuzzy boundaries in time that enables the accurate interpositioning of temporal entities between themselves taking into account the inherent fuzziness of temporal boundaries. This model

subsumes the earlier introduced Allen temporal relations which may continued to be used in extensions of the CIDOC CRM.

Spatiotemporal Relations (figure 5)

Treating space and time as separate entities is normally adequate for describing events and where things are. When more precise documentation and reasoning is required about phenomena spreading out over time, such as Bronze Age, a settlement, a nation, moving reference frames such as ships, things being stored in containers and moved around, built structures being partially destroyed, rebuilt and altered etc., space and time must be understood as a coherent continuum, the so-called spacetime. This is not a familiar concept for many users, and those not interested in such details may therefore skip this section.

However the respective model the CIDOC CRM adopts constitutes a valid interface to the OGC standards, as elaborated in CRMgeo (Doerr and Hiebel 2013) and important for connecting to GIS applications. The key class CIDOC CRM provides for modeling this information is *E92 Spacetime Volume*. *E92 Spacetime Volume* is used to document geometric extents in the physical spacetime containing actual or possible positions of things or happenings, in particular in those cases when the changes of place to be documented cannot be reduced to distinct events, because the spatial extent changes continuously. The higher level properties and classes of CIDOC CRM that centre around *E92 Spacetime Volume* allow for the documentation of: relations between spacetime volumes, relations to space and time as separate entities, and treating the exact extent of physical things and periods in space at any time of their existence as spacetime volumes. Its use is particularly elegant for the description of temporal gazetteers.
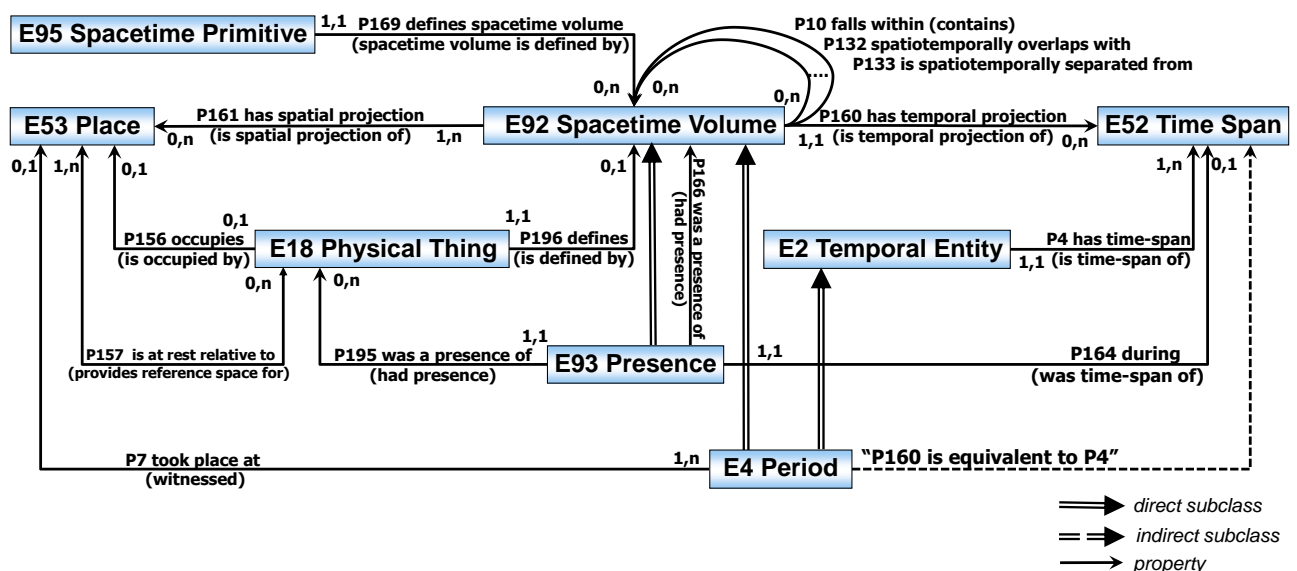

fig. 5 reasoning with spacetime volumes

Defining a Spacetime Volume: There are three ways to define a spacetime volume:

(1) the property *P169 defines spacetime volume* should be used to declare a spatiotemporal container for some things or happenings in terms of spatial coordinates that may vary over time, be it in discrete steps or continuously with the help of spacetime expressions. The latter are instances of *E95 Spacetime Primitive*, a primitive class for expressing values in data systems not further analyzed in the CIDOC CRM.

(2) Instances of *E4 Period* are regarded to be specialized instances of *E92 Spacetime Volume* that are formed by the spreading out of the phenomena that make up an instance of E4 Period. As such they are fuzzy but in general observable.

(3) The continuous sequence of spatial extent that the matter of an instance of E18 Physical Thing occupies in the course of time, defines a spacetime volume unique to it from the beginning of its existence to its end, which can also be understood as its trajectory through the universe The property *P169 defines* allows for referring to this spacetime volume, in order to document its additional properties. As such this spacetime volume is fuzzy but in general observable. It is not easy to make a mental picture of the spacetime volume of a physical thing, but the construct simplifies all reasoning about where things have been.

Relations with Places and Physical Things: The property *P161 has spatial projection* associates a spacetime

volume with the complete spatial extent it has occupied during its time-span of definition. Due to relativity of space, the definition of an instance of E53 Place must be relative to some physical thing as geometric reference. This can explicitly be documented with the property *P157 is at rest relative to*. If the place where something is at a certain point in time is given in multiple reference spaces in relative movement, such as with respect to a ship versus to the seafloor, these differently defined places may later move apart. Therefore, a spacetime volume, even though uniquely defined, can have any number of spatial projections, depending on the reference space. Currently, the GPS system defines a default reference space on the surface of Earth. In art conservation and other descriptions of mobile object of fixed shape, it is useful to refer to the precise place a physical thing occupies with respect to itself as reference space via *P156 occupies*, for further analysis. *P156 occupies* constitutes a particular projection of the spacetime volume of this thing. In contrast, the property *P53 has former or current location* only describes that a thing was within a specific place given in some reference space for an undefined time.

Relations with Time-Spans and Periods: The property *P160 has temporal projection* associates a spacetime volume with the complete temporal extent it has covered comprising all places of its definition. In contrast to places, the reference system of time is unique[5] except for the choice of origin. For instances of E4 Period and its subclasses, which inherit *P160 has temporal projection,* the property is actually identical with the property *P4 has time span* inherited from *E2 Temporal Entity,* because is describes the temporal extent of the phenomena that make up an instance of E4 Period. Therefore it is recommended to use *P4 has time span* for instances of E4 Period and its subclasses, rather than *P160 has temporal projection*.

Relations of Presence: Instances of *E93 Presence* are specialized instances of *E92 Spacetime Volume* that are identical with the spatial evolution of a larger spacetime volume specified by *P166 was presence of*, but delimited to a, normally short, time-span declared by *P164 during*. In other words, they constitute "snapshots" or "time-slices" of another spacetime volume, such as the extent of the Roman Empire during 30AD. They are the basic construct to describe exactly where something was or happened at a particular time (-span), in connection with the property *P161 has spatial projection.* In particular, it allows for describing the whereabouts of mobile objects, be it in the storage of a museum, a palace, deposited in the ground, or transported in a container, such as the bone of a saint. For ease of use, a shortcut *P195 was presence of* is defined directly to E18 Physical Thing, bypassing the definition of its spacetime volume.

Topological Relations: Finally the Model defines truly spatiotemporal topological relations. *P10 falls within (contains)* is the complete inclusion of one spacetime volume in another. It should not be confused with inclusion in the spatial and temporal projection, which may be larger. E.g. in 14 AD, Mesopotamia was not within the Roman Empire. Further, the properties *P132 spatiotemporally overlaps with* and its negation *P133 is spatiotemporally separated from* are fundamental to argue about temporary parthood, possible continuity etc.

Literature:

N. Guarino (ed.), *Formal Ontology in Information Systems. Proceedings of FOIS'98, Trento, Italy, 6-8 June 1998.* Amsterdam, IOS Press, pp. 3-15.
Carlo Meghini, Martin Doerr, 2018. *A first-order logic expression of the CIDOC*

ISSUE 434 scope note of E52 Time-Span

E52 Time-Span (old in 6.2.7)

Subclass of: E1 CRM Entity

Scope note: This class comprises abstract temporal extents, in the sense of Galilean physics, having a beginning, an end and a duration.

Time Span has no other semantic connotations. Time-Spans are used to define the temporal extent of instances of E4 Period, E5 Event and any other phenomena valid for a certain time.

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[5] This holds for applications in the scope of the CIDOC CRM, which are in the non-relativistic area, but not strictly, for instance, for satellites.

Since our knowledge of history is imperfect, instances of E52 Time-Span can best be considered as approximations of the actual Time-Spans of temporal entities. The properties of E52 Time-Span are intended to allow these approximations to be expressed precisely. An extreme case of approximation, might, for example, define an instance of E52 Time-Span having unknown beginning, end and duration. Used as a common E52 Time-Span for two events, it would nevertheless define them as being simultaneous, even if nothing else was known.

Automatic processing and querying of instances of E52 Time-Span is facilitated if data can be parsed into an E61 Time Primitive.

Examples:

- 1961
- From 12-17-1993 to 12-8-1996
- 14h30 – 16h22 4th July 1945
- 9.30 am 1.1.1999 to 2.00 pm 1.1.1999
- duration of the Ming Dynasty (*Chan*, 2011)

In First Order Logic:

E52(x) ⊃ E1(x)

E52 Time-Span (NEW)

E52 Time-Span

Subclass of: E1 CRM Entity

Scope note: This class comprises abstract temporal extents in the course of time, in the sense of Galilean physics, having a beginning, an end and a duration.

Instances of E52 Time-Span have no semantic connotations about phenomena happening within the temporal extent they represent. They do not convey any meaning other than a positioning on the "time-line" of chronology. The actual extent of an instance of E52 Time-Span can be approximated by properties of E52 Time-Span giving inner and outer bounds in the form of dates (instances of E61 Time Primitive). Comparing knowledge about time-spans is fundamental for chronological reasoning.

Some instances of E52 Time-Span may be defined as the actual, in principle observable, temporal extent of instances of E2 Temporal Entity via the property *P4 has time-span (is time-span of):* E52 Time-Span. They constitute phenomenal time-spans as defined in CRMgeo (Doerr and Hiebel 2013). Since our knowledge of history is imperfect and physical phenomena are fuzzy in nature, the extent of phenomenal time-spans can only be described in approximation. An extreme case of approximation, might, for example, define an instance of E52 Time-Span having unknown beginning, end and duration. It may, nevertheless, be associated with other descriptions by which we can infer knowledge about it, such as in relative chronologies.

Some instances of E52 may be defined precisely as representing a declaration of a temporal extent, as, for instance, done in a business contract. They constitute declarative time-spans as defined in CRMgeo (Doerr and Hiebel 2013) and can be described via the property E61 Time Primitive *P170 defines time (time is defined by)*: E52 Time-Span.

When used as a common E52 Time-Span for two events, it will nevertheless describe them as being simultaneous, even if nothing else is known.

Examples:

- 1961

- From 12-17-1993 to 12-8-1996
- 14h30 – 16h22 4th July 1945
- 9.30 am 1.1.1999 to 2.00 pm 1.1.1999
- duration of the Ming Dynasty (*Chan*, 2011)

In First Order Logic:

$$E52(x) \supset E1(x)$$

Properties:

P79 beginning is qualified by: E62 String

P80 end is qualified by: E62 String

P81 ongoing throughout: E61 Time Primitive

P82 at some time within: E61 Time Primitive

P83 had at least duration (was minimum duration of): E54 Dimension

P84 had at most duration (was maximum duration of): E54 Dimension

P86 falls within (contains): E52 Time-Span

P4 has time-span (is time-span of)

NEW

P4 has time-span (is time-span of)

Domain: E2 Temporal Entity

Range: E52 Time-Span

Quantification: many to one(0,1:0,n)

Scope note: This property associates an instance of E2 Temporal Entity with the instance of E52 Time-Span during which it was on-going. The associated instance of E52 Time-Span is understood as the real time-span during which the phenomena making up the temporal entity instance were active. More than one instance of E52 Temporal Entity may share a common instance of E52 Time-Span only if they come into being and end being due to an identical declarations or events.

Examples:

- the Yalta Conference (E7) *has time-span* Yalta Conference time-span (E52)

In First Order Logic:

$$P4(x,y) \supset E2(x)$$
$$P4(x,y) \supset E52(y)$$

OLD

P4 has time-span (is time-span of)

Domain: E2 Temporal Entity

Range: E52 Time-Span

Quantification: many to one, necessary, dependent (1,1:1,n)

Scope note: This property describes the temporal confinement of an instance of an E2 Temporal Entity.

The related instance of E52 Time-Span is understood as the real Time-Span during which the phenomena were active, which make up the temporal entity instance. It does not convey any other meaning than a positioning on the "time-line" of chronology. The Time-Span in turn is approximated by a set of dates (instances of E61 Time Primitive). Related temporal entities may share an instance of E52 Time-Span. Instances of E52 Time-Span may have completely unknown dates but other descriptions by which we can infer knowledge.

Examples:

- the Yalta Conference (E7) *has time-span* Yalta Conference time-span (E52)

In First Order Logic:

$$P4(x,y) \supset E2(x)$$
$$P4(x,y) \supset E52(y)$$

Issue 434 - P170 defines time (time is defined by)

NEW

P170 defines time (time is defined by)
Domain: E61Time Primitive
Range: E52 Time Span

Quantification: many to one, necessary, dependent (0,1:0,n)

Scope note: This property associates an instance of E61 Time Primitive with the instance of E52 Time-Span that constitutes the interpretation of the terms of the time primitive as an extent in absolute, real time.

In First Order Logic:

$$P170(x,y) \supset E61(x)$$
$$P170(x,y) \supset E52(y$$

OLD

P170 defines time (time is defined by)
Domain: E61Time Primitive
Range: E52 Time Span

Scope note: This property associates an instance of E61 Time Primitive with the instance of E52 Time-Span it defines.

In First Order Logic:

$$P170(x,y) \supset E61(x)$$
$$P170(x,y) \supset E52(y$$

ISSUE 458: proofreading of the scope notes for P79 through P82.

P79 beginning is qualified by

NEW

P79 beginning is qualified by
Domain: E52 Time-Span
Range: E62 String
Subproperty of: E1 CRM Entity. P3 has note: E62 String
Quantification: many to one (0,1:0,n)

Scope note: This property associates an instance of E52 Time-Span with a note detailing the scholarly or scientific opinions and justifications about the certainty, precision, sources etc of its beginning. Such notes may also be used to elaborate arguments about constraints or to give explanations of alternatives.

Examples:

- the time-span of the Holocene (E52) beginning is qualified by "The formal definition and dating of the GSSP (Global Stratotype Section and Point) for the base of the Holocene using the Greenland NGRIP ice core, and selected auxiliary records" (Walker et al 2009) (E62)

In First Order Logic:

$$P79 (x,y) \supset E52 (x)$$
$$P79 (x,y) \supset E62(y)$$
$$P79(x,y) \supset P3(x,y)$$

P79 beginning is qualified by

Domain: E52 Time-Span
Range: E62 String
Subproperty of: E1 CRM Entity. P3 has note: E62 String
Quantification: many to one (0,1:0,n)

Scope note: This property associates an instance of E52 Time-Span with a note detailing the scholarly or scientific opinions and justifications about the beginning of this time-span concerning certainty, precision, sources etc. This property may also be used to describe arguments constraining possible dates and to distinguish reasons for alternative dates.

Examples:

- the time-span of the Holocene (E52) beginning is qualified by "The formal definition and dating of the GSSP (GlobalStratotype Section and Point) for the base of theHolocene using the Greenland NGRIP ice core,and selected auxiliary records" (E62)

In First Order Logic:

$$P79 (x,y) \supset E52 (x)$$
$$P79 (x,y) \supset E62(y)$$
$$P79(x,y) \supset P3(x,y)$$

P80 end is qualified by

NEW

P80 end is qualified by

Domain: E52 Time-Span
Range: E62 String
Subproperty of: E1 CRM Entity. P3 has note: E62 String
Quantification: many to one (0,1:0,n)

Scope note: This property associates an instance of E52 Time-Span with a note detailing the scholarly or scientific opinions and justifications about the certainty, precision, sources etc of its end. Such notes may also be used to elaborate arguments about constraints or to give explanations of alternatives.

Examples:

- the time-span of the Holocene (E52) end is qualified by "still ongoing" (E62)

In First Order Logic:

$$P80(x,y) \supset E52(x)$$
$$P80(x,y) \supset E62(y)$$
$$P80(x,y) \supset P3(x,y)$$

P80 end is qualified by

Domain: E52 Time-Span
Range: E62 String
Subproperty of: E1 CRM Entity. P3 has note: E62 String
Quantification: many to one (0,1:0,n)

Scope note: This property associates an instance of E52 Time-Span with a note detailing the scholarly or scientific opinions and justifications about the end of this time-span concerning certainty, precision, sources etc. This property may also be used to describe arguments constraining possible dates and to distinguish reasons for alternative dates.

Examples:

- the time-span of the Holocene (E52) end is qualified by "still ongoing" (E62)

In First Order Logic:

P80(x,y) ⊃ E52(x)
P80(x,y) ⊃ E62(y)
P80(x,y) ⊃ P3(x,y)