**Issue 614 – 58th SIG meeting**

In the 58th CIDOC CRM SIG and 51st FRBR/LRMoo SIG meeting, PF presented a proposal for a new content model concerning I4 Proposition Set and Ixx Single Proposition Set, plus how it connects to the CRMbase model. For the details of the proposal (joint HW by MD and PF) see [here](https://cidoc-crm.org/sites/default/files/CRMinf_PropositionSet_E13-Belief%20Adoption.jpg).

The SIG proceeded with reviewing the proposed definitions for I4 Proposition Set (redrafting) and Ixx1 One-Proposition Set. Details of the proposal and the SIG’s feedback can be found below ([I4](#_I4_Proposition_Set), [Ixx1](#_Ixx1_One-Proposition_Set), [Jxx1](#_Jxx4_contains_entity), [Jxx2](#_Jxx2_is_formal), [Jxx3](#_Jxx3_that_formal), [Jxx4](#_Jxx4_contains_entity), [Jxx5](#_Jxx5_contains_property)).

**Overall discussion points**:

* Property needs relabeling: Jxx2 is formal meaning of ⇒ Jxx2 is a formal interpretation of. One cannot ascribe one single meaning to an information object.
* The purpose of introducing the Ixx1 One-Proposition Set modeling construct and connecting it with both E13 Attribute Assignment and I4 Proposition Set is twofold: first to allow single statements to be the content of an instance of I2 Belief and ascribe them a truth value.
	+ Difference of opinion registered wrt the necessity to introduce Ixx1 One-Proposition Set and properties to talk about single attributions and why not E13 is adequate for that in and of itself.
	+ The construct has not been grounded on some particular practical example; it was rather an attempt at resolving the incompatibility of the reification construct (which only supports a single statement) with knowledge graphs.
		- Nb. The scope-note for Ixx1 One-Proposition Set (see appendix) makes it clear that the E13.P140|P141: E1 and E13.P177:E55 typically shortcut over the full path will be defined in a knowledge base.
* Second, to indicate that an instance of E13 Attribute Assignment forms a particular kind of argument, i.e., one that is considered to be true. The shortcut is used, when the belief value of the singleton proposition set is true.

**Summary of decisions**:

1. New scope note for I4 Proposition Set, needs redrafting to read nicer.
2. Examples for Ixx1 One-Proposition Set need to be added –to consult the examples from the slide deck by AG.
3. Properties need examples before they are admitted in the model.

*Paris, March 2024*

## I4 Proposition Set

### NEW proposal:

**I4 Proposition Set**

Subclass of:

E89 Propositional Object

Superclass of:

I10 Provenance Statement

I11 Situation

Ixx1 One-Proposition Set

Scope note:

This class comprises sets of unambiguous propositions that are or could, in principle be, encoded in a knowledge representation language. These propositions should be factual, i.e., each proposition should pertain to at least one particular item, in contrast to universals, such as instances of E55 Type. The identity of an instance of I4 Proposition Set is given by the total of its content, regardless equivalent encodings.

An instance of I4 Proposition Set should be regarded per se to be neutral to its relationship to reality. The relationship to reality is determined by the link using the proposition set:

If an instance of I2 Belief refers to an instance of I4 Proposition Set, the belief value of "TRUE" will mean that the propositions are believed to correspond to reality, if the propositions can be related to reality (i.e., are about real-world items, in contrast to, e.g., mathematical statements). "FALSE" would mean that at least one of the propositions in the set is regarded to not correspond to reality. Belief values expressing possibility or probability will mean "possibly real" if the propositions can be related to reality.

Some properties associating an activity with an instance of I4 Proposition Set may imply the belief of the Actor carrying out the activity that the propositions are true. This should be expressed in the respective scope notes.

In a Knowledge Base implementation, an instance of I4 Proposition Set may be represented by the URI of a Named Graph, but only if the propositions are encoded in the data model of the Knowledge Base and held to be true by the maintainers of a Knowledge Base because they become part of the stated knowledge. In this case, the platform-internal relation between the URI and its content are regarded as equivalent to the property *Jxx1 is encoded by*. Proposition Sets held to be possibly true by the maintainers of a Knowledge Base may also be introduced as Named Graphs, if the operation of the Knowledge Base foresees filtering by provenance and likelihood. In this case, Named Graphs are particularly effective.

Examples:

* The proposition set with content:

{Nero in July 19, 64 AD (E93 Presence)

P164 is temporally specified by: July 19, 64 AD (E52 Timespan)
P195 was a presence of:  Nero Claudius Caesar Drusus Germanicus (E21 Person)

P167 was within: Antium in 64AD, Italy (E53 Place)

P133 is spatiotemporally separated from: The Great Fire of Rome (E5 Event)

P1 is identified by: incendium magnum Romae (E41 Appellation)

P4 has timespan: July 19-27, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

 } (Bologna 2021)

* The proposition set with content:

{Nero July 19, 64 AD (E93 Presence)

P164 is temporally specified by: July 19, 64 AD (E52 Timespan)

P195 was a presence of: Nero Claudius Caesar Drusus Germanicus (E21 Person)

P167 was within Rome in 64AD, Italy (E53 Place)

P10 falls within (contains): Nero Singing (E7 Activity)

P2 has type: Singing (E55 Type)

P14 carried out by: Nero Claudius Caesar Drusus Germanicus (E21)

P4 has timespan: July 19, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

P132 spatiotemporally overlaps with: The Great Fire of Rome (E5 Event)

P1 is identified by: incendium magnum Romae (E41 Appellation)

P4 has timespan: July 19-27, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

}(I4) (Bologna 2021)

In First Order Logic:

I4(x) ⇒ E73(x)

Properties:

Jxx1 is encoded by: E52 String

Jxx2 is formal meaning of (has formal meaning): E73 Information Object

Jxx4 contains entity (is contained in): E1 CRM Entity

Jxx5 contains property type (is property type in): E55 Type

### OLD definition

**I4 Proposition Set**

Subclass of: E73 Information Object

Superclass of:

I10 Provenance Statement

Scope note:

This class comprises the sets of formal, binary propositions that an I2 Belief is held about. It could be implemented as a named graph, a spreadsheet, or any other structured dataset. Regardless of the specific syntax employed, the effective propositions it contains should be made up of unambiguous identifiers, concepts of a formal ontology, and constructs of logic.

Examples:

* {Nero in July 19, 64 AD (E93 Presence)

 P164 is temporally specified by: July 19, 64 AD (E52 Timespan)

 P195 was a presence of: Nero Claudius Caesar Drusus Germanicus (E21 Person)

 P167 was within Antium in 64AD, Italy (E53 Place)

 P133 is spatiotemporally separated from: The Great Fire of Rome (E5 Event)

P1 is identified by: incendium magnum Romae (E41 Appellation)

P4 has timespan: July 19-27, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

 } (Bologna 2021)

[The Proposition Set above represents Francesca Bologna’s adopted belief, according to which Publius Cornelius Tacitus meant that “Nero was at Antium when the Great Fire broke out and did not return to Rome until the fire approached his house”]

* {Nero July 19, 64 AD (E93 Presence)

P164 is temporally specified by: July 19, 64 AD (E52 Timespan)

P195 was a presence of: Nero Claudius Caesar Drusus Germanicus (E21 Person)

P167 was within Rome in 64AD, Italy (E53 Place)

P10 falls within (contains): Nero Singing (E7 Activity)

P2 has type: Singing (E55 Type)

P14 carried out by: Nero Claudius Caesar Drusus Germanicus (E21)

P4 has timespan: July 19, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

P132 spatiotemporally overlaps with: The Great Fire of Rome (E5 Event)

P1 is identified by: incendium magnum Romae (E41 Appellation)

P4 has timespan: July 19-27, 64 AD (E52 Timespan)

P7 took place at: Rome in 64AD, Italy (E53 Place)

}(I4) (Bologna 2021)

[The Proposition Set above represents Francesca Bologna’s intended meaning belief, according to which Gaius Suetonius Tranquillus assumed that Nero was singing in Rome while it was burning from July 19 in 64 AD.]

In First Order Logic:

I4(x) ⇒ E73(x)

Properties:

### Discussion points concerning **I4 Proposition Set**:

* The scope note does not read nicely, needs rewriting.
* The examples are helpful (in the sense that they form triples)
* KB: substitute for knowledge base

## Ixx1 One-Proposition Set

### Proposed definition:

**Ixx1 One-Proposition Set**

Subclass of:

I4 Proposition Set

Scope note:

This class comprises proposition sets containing exactly one binary proposition which is or could, in principle be, encoded in a knowledge representation language. The identity of an instance of Ixx1 One-Proposition Set is given by the total of its content, regardless equivalent encodings.

A property linking to an instance of Ixx1 One-Proposition Set in a Knowledge Base may alternatively be implemented by a “reification” construct, and is regarded as logically equivalent in this model. Similarly, all triples of properties declared for one class to denote the domain, type and range of another property, such as the properties of E13 Attribute Assignment and its subclasses, can be interpreted as shortcuts to an instance of Ixx1 One-Proposition Set and its properties *Jxx6 has domain (is domain of), Jxx7 has range (is range of), Jxx8 has property type (is property type of)*, or as a “reification” implicit to the declaring class.

As such, the class Ixx1 One-Proposition Set plays the role of an important *logical interface* between different ways to document a discourse about propositions within a Knowledge Base in different ways. In practice, the use of shortcut properties will typically be preferred for documentation purposes.

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Ixx1(x) ⇒ I4(x)

**Ixx1(x) ⇒  (∃uvw) [E1(u) ˄ Jxx6(x,u) ˄ E1(v) ˄ Jxx7(x,v) ˄ E55(w) ˄ Jxx8(x,w)]**

Properties:

Jxx6 has domain (is domain of): E1 CRM Entity

Jxx7 has range (is range of): E1 CRM Entity

Jxx8 has property type (is property type of): E55 Type

### Discussion points concerning **Ixx1 One-Proposition Set**:

* KB: substitute for knowledge base
* The examples will need to show the equivalence with the reification construct (through E13).
* Each statement in a knowledge base forms a one-proposition set. Each of these statements can either have an attribute assignment (to mark the provenance of the statement) attached to it or not.
	+ In the absence of an attribute assignment, the source of the statement is the organization that curates the knowledge base.
	+ In case the maintainers of the knowledge base want to indicate the provenance of the statement (scholar x), and that they agree with its contents, then they can use the shortcut properties of CRMbase (P140 | P141 | P177), rather than explicitly mention the belief adoption process on the part of the knowledge base maintainers, whereby the particular statement was adopted as the content of their belief.
* It is not the case that every system makes an explicit reference to the provenance of each statement (in the sense of who created/ updated a given record and when). Migrating from one system to another would not necessarily mean that the maintainers of a knowledge base need to add provenance statements to all of its statements.
* If one is integrating data from another organization, again they don’t need to add provenance statements to all the statements therein, but they can import them as a named graph and make them the subject of an I2 Belief.
	+ What is needed is some guidelines on how to do data integration and document searchable paradata together with the data.
* Examples by AG about querying virtual reconstruction arguments (qua proposition sets) in a scientific context and reason about these proposition sets. See here for [slides](https://drive.google.com/file/d/1Ad611X-MmFjHU90jVMwn9lcz1h6bi3fi/view?usp=drive_link) and [paper](https://drive.google.com/file/d/1Ae3pgrS3AtF2PYeT80jVPuWwXp5s7XuU/view?usp=drive_link).
	+ Especially the slides 21 through 25, can be used as examples for Ixx1 One-Proposition Set.
	+ The example showcases the evolution of documentation (moving from simple arguments to more refined ones).

## Jxx1 is encoded by -Proposal for new property:

### Proposed definition:

**Jxx1 is encoded by**

Domain:

I4 Proposition Set

Range:

E62 String

Superproperty of:

<???>

Subproperty of:

<???>

Quantification:

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

Scope note:

This property associates an instance of I4 Proposition Set with a “serialization” of its content in the format of a knowledge representation language. There may be more than one ontologically equivalent formal encodings of the same propositions.

In a Knowledge Base implementation, the content of an instance of I4 Proposition Set may be represented by the content of a Named Graph, but only if the propositions are encoded in the data model of the Knowledge Base  and held to be true by the maintainers of a Knowledge Base  because they become part of the stated knowledge. In this case, the platform-internal relation between the URI of the Named Graph and its content are regarded as equivalent to *Jxx1 is encoded by*, and the property should formally not be instantiated.

Full path:

<???>

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Jxx1(x,y) ⇒ I4(x)

Jxx1(x,y) ⇒ E62(y)

### Discussion points concerning Jxx1 is encoded by:

* KB: substitute for knowledge base
* The property needs examples

## Jxx2 is formal meaning of (has formal meaning)

### Proposed definition:

**Jxx2 is a formal meaning of (has a formal meaning)**

Domain:

I4 Proposition Set

Range:

E73 Information Object

Superproperty of:

Subproperty of:

E1 CRM Entity. P129i is about (is subject of): E89 Propositional Object

Quantification:

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

Scope note:

This property associates an instance of I4 Proposition Set with an instance of E73 Information Object that expresses the content of the former as propositions that are or could, in principle be, encoded in a knowledge representation language.

These propositions should be unambiguous at least within the context of provenance of the information object and the context of documenting them as the content of the instance of I4 Proposition Set. For a textual representation, rules of a normal scholarly consensus should be applied

Full path:

<???>

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Jxx2(x,y) ⇒ I4(x)

Jxx2(x,y) ⇒ E78(y)

Jxx2(x,y) ⇒ P129(y,x)

### Discussion points concerning Jxx2 is formal meaning of (has formal meaning):

* Relabel *Jxx2 is* ***a*** *formal meaning of (has* ***a*** *formal meaning)*
* Suggestion: remove the clause “To be overly critical about possible ambiguities would be counterproductive in practice” from the scope note.
* The property needs examples

## Jxx3 that formal meaning of (has meaning belief)

### Proposed definition:

**Jxx3 that a formal meaning of (has a meaning belief)**

Domain:

I2 Belief

Range:

E78 Information Object

Superproperty of:

<???>

Subproperty of:

<???>

Quantification:

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

Scope note:

This property associates an instance of I2 Belief with an instance of E73 Information Object that expresses the believed propositions in a form that are or could, in principle be, encoded in a knowledge representation language.

This property is a strong shortcut of the fully developed path from I2 Belief, *J4 that (is subject of)*, I4 Proposition Set, *Jxx2 is formal meaning of (has formal meaning)* to E73 Information Object. It is introduced into this model for the convenience of the user, when the implied instance of I4 Proposition Set appears not to be a separate object of discourse within this documentation context.

Full path:

<???>

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Jxx3(x,y) ⇒ I2(x)

Jxx3(x,y) ⇒ E78(y)

Jxx3(x,y) ⇔  (∃u) [I4(u) ˄ J4(x,u) ˄ Jxx2(u,y)

### Discussion points concerning Jxx3 that formal meaning of (has meaning belief):

* Relabel *Jxx3 that* ***a*** *formal meaning of (has* ***a*** *meaning belief)*
* The property needs examples

## Jxx4 contains entity (is contained in)

### Proposed definition:

**Jxx4 contains entity (is contained in)**

Domain:

I4 Proposition Set

Range:

E1 CRM Entity

Superproperty of:

Ixx1 One-Proposition Set. Jxx6 has domain (is domain of): E1 CRM Entity

Ixx1 One-Proposition Set. Jxx7 has range (is range of): E1 CRM Entity

I10 Provenance Statement. J20 is about the provenance of (has provenance claim): E70 Thing

Subproperty of:

E89 Propositional Object. P67 refers to (is referred to by): E1 CRM Entity

Quantification:

many to many, necessary (2,n:0,n)

Scope note:

This property associates an instance of I4 Proposition Set with an instance of E1 CRM Entity that appears as an element of one or more propositions in the content of the former.

This property serves on one side to relate an instance of I4 Proposition Set to other contexts of interest, in particular when its content is or cannot be represented as a Named Graph in the same knowledge base. On the other hand, it plays an important structural role in this model for expressing constraints to the content of an instance of I4 Proposition Set or one of its subclasses.

Full path:

<???>

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Jxx4(x,y) ⇒ I4(x)

Jxx4(x,y) ⇒ E1(y)

Jxx4(x,y) ⇒ P67(x,y)

### Discussion points concerning Jxx4 contains entity (is contained in):

* “element of one or more propositions”, refers to the domain or range class of an instance of a property in a proposition set, i.e., the subject or object of a statement in a triple.
* Examples and use cases to be provided before the property is accepted.

## Jxx5 contains property type (is property type in)

### Proposed definition:

**Jxx5 contains property type (is property type in)**

Domain: I4 Proposition Set

Range: E55 Type

Superproperty of: Ixx1 One-Proposition Set. Jxx8 has property type (is property type of): E55 Type

Subproperty of: E89 Propositional Object. P67 refers to (is referred to by): E1 CRM Entity

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

Scope note: This property associates an instance of I4 Proposition Set with an instance of E55 Type that appears as property type in one or more propositions in the content of the former.

This property plays an important structural role in this model for expressing constraints to the content of an instance of I4 Proposition Set or one of its subclasses.

Full path:

<???>

Examples:

* <example 1>
* <example 2>

In First Order Logic:

Jxx5(x,y) ⇒ I4(x)

Jxx5(x,y) ⇒ E55(y)

Jxx5(x,y) ⇒ P67(x,y)

### Discussion points concerning Jxx5 contains property type (is property type in):

* Examples and use cases to be provided before the property is accepted.

Way to move forward:

* Improve the scope notes, and add examples that show the equivalence with the reification construct. Make sure to reference the example by AG.
* Add the guidelines on data integration to the introduction of CRMinf or make it a paper that is referenced by the CRMinf introduction.