Dear All,

The current problem of S4 Observation is the single-property formulation, dictated by E13 Attribute Assignment, but compatible with INSPIRE and E16 Measurement. On the other side, it will never allow for observing distances. Therefore, in order to proceed the generalization of Measurement in CRMsci, we can take two paths:

A) Consider a minimal change in the definition of S15 Observable Entity and S4 Observation, generalize E16 Measurement with these definitions, and later revise S15,S4 to be a wider generalization. This will leave us with a consistent intermediate stage.
B) Begin with change in the definition of S15 Observable Entity and S4 Observation, Issue 531, and then rework all properties.

I describe here solution A:

(Change S15 Observable Entity to superclass of E5 Event, S10 Material Substantial, Issue 531)

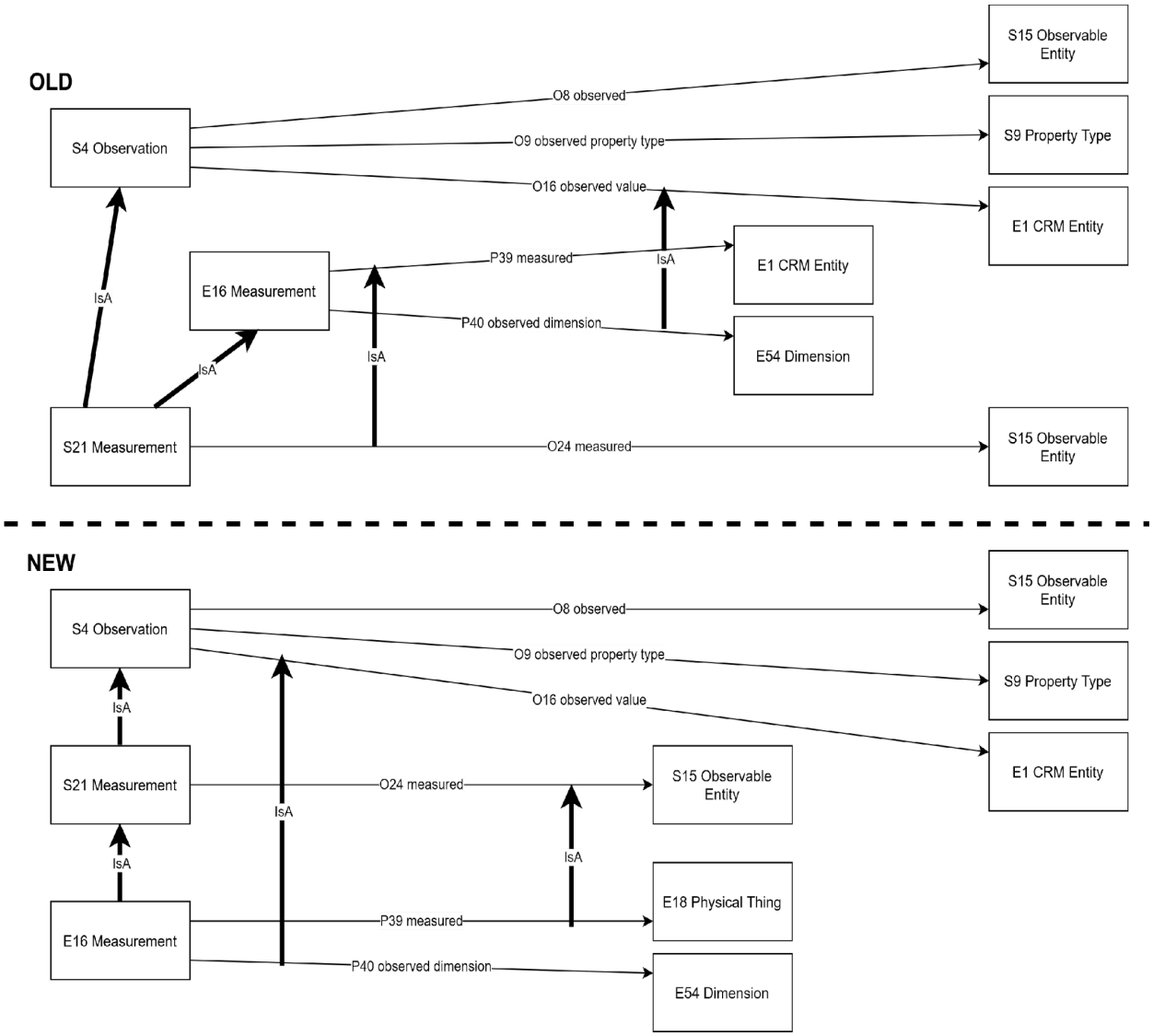
Change S21 Measurement to superclass of E16 Measurement.

Change O24 measured (was measured by) to superproperty of P39 measured (was measured by).

Confirm! O16 observed value (value was observed by) to be superproperty of P40 observed dimension (was observed in).

Declare O12 to be identical with P43 for E18 Physical Thing, which is the intersection of E70 Thing and S15 Observable Entity.

O9 observed property type (property type was observed by) : subproperty of P177 assigned property of type (is type of property assigned)




**Implementation:**

# OLD:

### S21 Measurement

Subclass of: S4 Observation
E16 Measurement

Superclass of: S3 Measurement by Sampling

Scope note: This class comprises actions measuring instances of E2 Temporal Entity or E77 Persistent Items, properties of physical things, or phenomena, states and interactions or events, that can be determined by a systematic procedure. Primary data from measurement devices are regarded to be results of an observation process.

In First Order Logic:

S21(x) ⊃ S4(x)
S21(x) ⊃ E16(x)

Properties:

O24 measured (was measured by): S15 Observable Entity

# NEW:

### S21 Measurement

Subclass of: S4 Observation

Superclass of: S3 Measurement by Sampling
E16 Measurement

Scope note: This class comprises actions measuring instances of S15 Observable Entity, properties of physical things, or phenomena, states and interactions or events, that can be determined by a systematic procedure. Primary data from measurement devices are regarded to be results of an observation process.

Examples:

- The magnitude measurement of the earthquake of Mexico city in 2017. (S21) [It had the magnitude 6.2 Richter] (Mindock, 2017) (http://www.independent.co.uk/news/world/americas/mexico-earthquake-today-latest-mexico-city-magnitude-6-tremor-damage-a7963211.html ).
- The sensor measurement by IGME in 1999 which measured the landslide displacement in the area of Parnitha, Greece. (S21) (InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)

In First Order Logic:

S21(x) ⊃ S4(x)

Properties:

O24 measured (was measured by): S15 Observable Entity

**Note** that *P40 observed dimension (was observed in)*: E54 Dimension is now missing from S21, but *O16 observed value (value was observed by)*: E1 CRM Entity is valid.

# CONFIRM O16:

### O16 observed value (value was observed by)

Domain: S4 Observation
Range: E1 CRM Entity
Subproperty of: E13 Attribute Assignment. P141 assigned (was assigned by): E1 CRM Entity
Superproperty of: E16 Measurement. P40 observed dimension (was observed in): E54 Dimension (inconsistent with E21 Measurement as long as Observable Entity is not moved to CRM.
Quantification: many to one, necessary (1,1:0,n)

Scope note: This property associates a value assigned to an entity observed by S4 Observation.

Examples:

- The surface survey at the bronze age site of Mitrou in east Lokris carried out by Cornell

University in 1989 *observed value* 600 (of sherds).) (Kramer-Hajos and O'Neill , 2008).

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In First Order Logic:

O16(x,y) ⊃ S4(x)
O16(x,y) ⊃ E1(y)
O16(x,y) ⊃ P141(x,y)

# NEW:

### O16 observed value (value was observed by)

Domain: S4 Observation
Range: E1 CRM Entity

Subproperty of: E13 Attribute Assignment. P141 assigned (was assigned by): E1 CRM Entity

Superproperty of: E16 Measurement. P40 observed dimension (was observed in): E54 Dimension

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

Scope note: This property associates a value assigned to an entity observed by S4 Observation.

Examples:

- The surface survey at the bronze age site of Mitrou in east Lokris carried out by Cornell University in 1989 *observed value* 600 (of sherds).) (Kramer-Hajos and O'Neill , 2008).
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In First Order Logic:

O16(x,y) ⊃ S4(x)
O16(x,y) ⊃ E1(y)
O16(x,y) ⊃ P141(x,y)

# OLD O24:

### O24 measured (was measured by)

Domain: S21 Measurement
Range: S15 Observable Entity
Subproperty of: S4 Observation. O8 observed (was observed by): S15 Observable Entity
E16 Measurement. P39 measured (was measured by): E1 CRM Entity

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

Scope note: This property associates an instance of S21 Measurement with the instance of S15 Observable Entity to which it applied. An instance of S15 Observable Entity may be measured more than once. Material and immaterial things and processes may be measured, e.g. the number of words in a text, or the duration of an event.

Examples:

- The sensor measurement by IGME in 1999 (S21) *measured* the landslide displacement (S15)

in the area of Parnitha.(InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)

In First Order Logic:

O24(x,y) ⊃ S21(x)
O24(x,y) ⊃ S15(y)
O24(x,y) ⊃ O8(x,y)
O24(x,y) ⊃ P39(x,y)

# NEW:

### O24 measured (was measured by)

Domain: S21 Measurement
Range: S15 Observable Entity

Subproperty of: S4 Observation. O8 observed (was observed by): S15 Observable Entity

Superproperty of: E16 Measurement. P39 measured (was measured by): E18 Physical Thing

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

Scope note: This property associates an instance of S21 Measurement with the instance of S15 Observable Entity to which it applied. An instance of S15 Observable Entity may be measured more than once. Material and immaterial things and processes may be measured, e.g. the number of words in a text, or the duration of an event.

Examples:

- The sensor measurement by IGME in 1999 (S21) *measured* the landslide displacement (S15) in the area of Parnitha.(InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)

In First Order Logic:

O24(x,y) ⊃ S21(x)
O24(x,y) ⊃ S15(y)
O24(x,y) ⊃ O8(x,y)

**NOTE:** This change became possible by reducing the range of P39 !

# OLD O12:

### O12 has dimension (is dimension of)

Domain: S15 Observable Entity
Range: E54 Dimension
Quantification: one to many, dependent (0,n:1,1)

Scope note: This property associates an instance of S15 Observable Entity with an instance of E54 Dimension that the observable entity has.

It offers no information about how and when an E54 Dimension was established.

Examples:

- The earthquake of Mexico city in 2017 *had dimension* magnitude 6.2 Richter (Mindock, 2017, http://www.independent.co.uk/news/world/americas/mexico-earthquake-today-latest-mexico-city-magnitude-6-tremor-damage-a7963211.html ).
- The landslide that was activated in Parnitha in 1999 after the earthquake, *had* dimension crest length > 70 (InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)

In First Order Logic:

O12(x,y) ⊃ S15(x)
O12(x,y) ⊃ E54(y)

# NEW:

### O12 has dimension (is dimension of)

Domain: S15 Observable Entity
Range: E54 Dimension
Quantification: one to many, dependent (0,n:1,1)

Scope note: This property associates an instance of S15 Observable Entity with an instance of E54 Dimension that the observable entity has.
It offers no information about how and when an E54 Dimension was established.

Examples:

- The earthquake of Mexico city in 2017 *had dimension* magnitude 6.2 Richter (Mindock, 2017, http://www.independent.co.uk/news/world/americas/mexico-earthquake-today-latest-mexico-city-magnitude-6-tremor-damage-a7963211.html ).
- The landslide that was activated in Parnitha in 1999 after the earthquake, *had* dimension crest length > 70 (InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)

In First Order Logic:

O12(x,y) ⊃ S15(x)
O12(x,y) ⊃ E54(y)
[O12(x,y) ∧ E18(x)] ⇒ P43(x,y)
[P43(x,y) ∧ E18(x)] ⇒ O12(x,y)

**NOTE:** We declare P43 has dimension (is dimension of): E54 Dimension to be equivalent to O12 for the intersection of S15 and E70.

# OLD O9:

### O9 observed property type (property type was observed by)

Domain: S4 Observation
Range: S9 Property Type

Subproperty of: E1 CRM Entity. P2 has type: E55 Type
Quantification: one to one (1,1:0,n)

Scope note: This property associates an instance of S4 Observation with the instance of S9 Property Type for which the observation provides a value or evidence, such as "concentration of nitrate" observed in the water from a particular borehole. Encoding the observed property by type, observed entity and value (properties O9, O10, O16) is a method to circumscribe the reification of the observed property by the respective instance of S4 Observation.

In an RDFS encoding, this circumscription can be transformed into an explicit representation of the observed property in terms of a formal ontology either by use of a reification construct or by the use of a Named Graph containing the observed property. The latter representation allows for more formal reasoning with the model, the former is more flexible about the kinds of observations.

Examples:

- The seismic hazard analysis and recording by EPPO in 1990 (S4), in the area of Attiki *observed* and recorded *property type* share wave velocity (S9) (InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)
- The Gas Chromatography analysis (S4) of the sample "mid-blue paint from the sky" *observed property type* retention time (S9). (Foister, S. 2015)

# NEW:

### O9 observed property type (property type was observed by)

Domain: S4 Observation
Range: S9 Property Type

Subproperty of: E13 Attribute Assignment. P177 assigned property type: E55 Type

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

Scope note: This property associates an instance of S4 Observation with the instance of S9 Property Type for which the observation provides a value or evidence, such as "concentration of nitrate" observed in the water from a particular borehole. Encoding the observed property by type, observed entity and value (properties O9, O10, O16) is a method to circumscribe the reification of the observed property by the respective instance of S4 Observation.

In an RDFS encoding, this circumscription can be transformed into an explicit representation of the observed property in terms of a formal ontology either by use of a reification construct or by the use of a Named Graph containing the observed property. The latter representation allows for more formal reasoning with the model, the former is more flexible about the kinds of observations.

Examples:

- The seismic hazard analysis and recording by EPPO in 1990 (S4), in the area of Attiki *observed* and recorded *property type* share wave velocity (S9) (InGeoCloudS - INspiredGEOdata CLOUD Services D2.2 2012;D2.3 2013)
- The Gas Chromatography analysis (S4) of the sample "mid-blue paint from the sky" *observed property type* retention time (S9). (Foister, S. 2015)

In First Order Logic:

$O9(x,y) \supset S4(x)$

O9(x,y) ⊃ S9(y)
O9(x,y) ⊃ P177(x,y)