Definition of CRMdig v 4.0

Version: 4.0 unstable

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Introduction

Scope

CRM Digital is an ontology and RDF Schema to encode metadata about the steps and methods of production ("provenance") of digitization products and synthetic digital representations such as 2D, 3D or even animated Models created by various technologies. Its distinct features compared to competitive models is the complete inclusion of the initial physical measurement processes and their parameters. It has been developed as compatible extension of CIDOC CRM, which allows for querying the most relevant facts and returning complete descriptions encoded in this model by generic ISO21127 terms without need to refer to its specific properties. In contrast, competitive models cannot be queried by a more general standard and are restricted to the computational provenance only. Data encoded in the major competitive models can be transformed without loss of meaning into a CRM-Digital-form.

Status

Published version
CRMdig v 4.0 class hierarchy, aligned with portions from the CIDOC CRM hierarchy

This class hierarchy lists:

- all classes declared in CRMdig v 4.0
- all classes declared in CIDOC CRM version 7.1.1 that are declared as superclasses of classes declared in the CRMdig v 4.0
- all classes declared in CIDOC CRM version 7.1.1 that are either domain or range for a property declared in the CRMdig v 4.0

**Table 1: Class Hierarchy**

<table>
<thead>
<tr>
<th>Code</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>CRM Entity</td>
</tr>
<tr>
<td>D13</td>
<td>Digital Information Carrier</td>
</tr>
<tr>
<td>E11</td>
<td>Modification</td>
</tr>
<tr>
<td>D7</td>
<td>Digital Machine Event</td>
</tr>
<tr>
<td>D10</td>
<td>Software Execution</td>
</tr>
<tr>
<td>D3</td>
<td>Formal Derivation</td>
</tr>
<tr>
<td>D11</td>
<td>Digital Measurement Event</td>
</tr>
<tr>
<td>D2</td>
<td>Digitization Process</td>
</tr>
<tr>
<td>D12</td>
<td>Data Transfer Event</td>
</tr>
<tr>
<td>E16</td>
<td>Measurement</td>
</tr>
<tr>
<td>D11</td>
<td>Digital Measurement Event</td>
</tr>
<tr>
<td>D2</td>
<td>Digitization Process</td>
</tr>
<tr>
<td>E22</td>
<td>Human-Made Object</td>
</tr>
<tr>
<td>D8</td>
<td>Digital Device</td>
</tr>
<tr>
<td>E26</td>
<td>Physical Feature</td>
</tr>
<tr>
<td>D35</td>
<td>Area</td>
</tr>
<tr>
<td>E54</td>
<td>Dimension</td>
</tr>
<tr>
<td>D9</td>
<td>Data Object</td>
</tr>
</tbody>
</table>
List of external classes used in CRMdig v 4.0

Table 2: List of external classes grouped by model and ordered by model (exception: CRMbase always goes first) and then by class identifier.

<table>
<thead>
<tr>
<th>Class identifier</th>
<th>Class name</th>
<th>Model</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>CRM Entity</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E11</td>
<td>Modification</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E16</td>
<td>Measurement</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E18</td>
<td>Physical Thing</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E22</td>
<td>Human-Made Object</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E26</td>
<td>Physical Feature</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E54</td>
<td>Dimension</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E55</td>
<td>Type</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E65</td>
<td>Creation</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E73</td>
<td>Information Object</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>E89</td>
<td>Propositional Object</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
</tbody>
</table>
CRMdig v 4.0 property hierarchy, aligned with portions from the CIDOC CRM hierarchy

This property hierarchy lists:

- all properties declared in CRMdig v 4.0
- all properties declared in CIDOC CRM version 7.1.1 that are declared as superproperties of properties declared in the CRMdig v 4.0

<table>
<thead>
<tr>
<th>Property id</th>
<th>Property Name</th>
<th>Entity – Domain</th>
<th>Entity - Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3</td>
<td>has note</td>
<td>E1 CRM Entity</td>
<td>E62 String</td>
</tr>
<tr>
<td>L47</td>
<td>- has comment</td>
<td>E1 CRM Entity</td>
<td>E62 String</td>
</tr>
<tr>
<td>P12</td>
<td>occurred in the presence of (was present at)</td>
<td>E5 Event</td>
<td>E77 Persistent Item</td>
</tr>
<tr>
<td>L12</td>
<td>- happened on device (was device for)</td>
<td>D7 Digital Machine Event</td>
<td>D8 Digital Device</td>
</tr>
<tr>
<td>L15</td>
<td>- has sender (was sender for)</td>
<td>D12 Data Transfer Event</td>
<td>D8 Digital Device</td>
</tr>
<tr>
<td>L16</td>
<td>- has receiver (was sender for)</td>
<td>D12 Data Transfer Event</td>
<td>D8 Digital Device</td>
</tr>
<tr>
<td>P14</td>
<td>carried out by (performed)</td>
<td>E7 Activity</td>
<td>E39 Actor</td>
</tr>
<tr>
<td>L29</td>
<td>- has responsible organization (is responsible organization for)</td>
<td>E7 Activity</td>
<td>E40 Legal Body</td>
</tr>
<tr>
<td>L34</td>
<td>- has contractor (is contractor for)</td>
<td>E7 Activity</td>
<td>E40 Legal Body</td>
</tr>
<tr>
<td>L35</td>
<td>- has commissioner (is commissioner for)</td>
<td>E7 Activity</td>
<td>E40 Legal Body</td>
</tr>
<tr>
<td>L30</td>
<td>- has operator (is operator of)</td>
<td>E7 Activity</td>
<td>E21 Person</td>
</tr>
<tr>
<td>P16</td>
<td>used specific object (was used for)</td>
<td>E7 Activity</td>
<td>E70 Thing</td>
</tr>
</tbody>
</table>
- had input (was input of)
  D7 Digital Machine Event  D1 Digital Object

- used as source (was source for)
  D10 Software Execution  D1 Digital Object

- used as derivation source (was derivation source for)
  D3 Formal Derivation  D1 Digital Object

- used parameters (parameters for)
  D10 Software Execution  D1 Digital Object

- transferred (was transferred by)
  D12 Data Transfer Event  D1 Digital Object

- used software or firmware (was software or firmware used by)
  D7 Digital Machine Event  D14 Software

has modified (was modified by)
  E11 Modification  E18 Physical Thing

- has modified (was modified by)
  D7 Digital Machine Event  D13 Digital Information Carrier

measured (was measured by)
  E16 Measurement  E18 Physical Thing

- digitized (was digitized by)
  D2 Digitization Process  E18 Physical Thing

observed dimension (was observed in)
  E16 Measurement  E54 Dimension

- has created (was created by)
  D11 Digital Measurement Event  D9 Data Object

ongoing throughout
  E52 Time-Span  E61 Time Primitive

- was ongoing at
  D7 Digital Machine Event  E61 Time Primitive

has value
  E54 Dimension  E60 Number

- has pixel width
  D9 Data Object  E60 Number

- has pixel height
  D9 Data Object  E60 Number

has created (was created by)
  E65 Creation  E28 Conceptual Object

- had output (was output of)
  D7 Digital Machine Event  D1 Digital Object

- has created (was created by)
  D11 Digital Measurement Event  D9 Data Object

- created derivative (was derivative created by)
  D3 Formal Derivation  D1 Digital Object
List of external properties used in CRMdig v 4.0

Table 4: List of external properties grouped by model and ordered by model and then by property identifier.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
<th>CRM Model</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3</td>
<td>has note</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P12</td>
<td>occurred in the presence of (was present at)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P14</td>
<td>carried out by (performed)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P16</td>
<td>used specific object (was used for)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P31</td>
<td>has modified (was modified by)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P39</td>
<td>measured (was measured by)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>P40</td>
<td>observed dimension (was observed in)</td>
<td>CIDOC CRM</td>
<td>7.1.1</td>
</tr>
<tr>
<td>Property Code</td>
<td>Description</td>
<td>CIDOC CRM</td>
<td>Version</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>P81</td>
<td>ongoing throughout</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P90</td>
<td>has value</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P94</td>
<td>has created (was created by)</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P106</td>
<td>is composed of (forms part of)</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P125</td>
<td>used object of type (was type of object used in)</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P128</td>
<td>carries (is carried by)</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
<tr>
<td>P140</td>
<td>assigned attribute to (was attributed by)</td>
<td>CIDOC CRM</td>
<td>7.1.1.</td>
</tr>
</tbody>
</table>
The classes are comprehensively declared in this section using the following format:

- Class names are presented as headings in bold face, preceded by the class’ unique identifier;
- The line “Subclass of:” declares the superclass of the class from which it inherits properties;
- The line “Superclass of:” is a cross-reference to the subclasses of this class;
- The line “Scope note:” contains the textual definition of the concept the class represents;
- The line “Examples:” contains a bulleted list of examples of instances of this class.
- The line “Properties:” declares the list of the class’s properties;
- Each property is represented by its unique identifier, its forward name and the range class that it links to, separated by colons;
- Inherited properties are not represented;

**D1 Digital Object**

**Subclass of:**

E73 Information Object

**Superclass of:**

D9 Data Object
D14 Software
D35 Area

**Scope note:**

This class comprises identifiable immaterial items that can be represented as sets of bit sequences, such as data sets, e-texts, images, audio or video items, software, etc., and are documented as single units.

Any aggregation of instances of D1 Digital Object into a whole treated as single unit is also regarded as an instance of D1 Digital Object.

This means that for instance, the content of a DVD, an XML file on it, and an element of this file, are regarded as distinct instances of D1 Digital Object, mutually related by the P106 is composed of (forms part of) property.

A D1 Digital Object does not depend on a specific physical carrier, and it can exist on one or more carriers simultaneously.
In First Order Logic:

\[ D1(x) \Rightarrow E73(x) \]

D2 Digitization Process

Subclass of:

D11 Digital Measurement Event

Scope note:

This class comprises events that result in the creation of instances of D9 Data Object that represent the appearance and/or form of an instance of E18 Physical Thing such as paper documents, statues, buildings, paintings, etc.

A particular case is the analogue-to-digital conversion of audiovisual material.

This class represents the transition from a material thing to an immaterial representation of it.

The characteristic subsequent processing steps on digital objects are regarded as instances of D3 Formal Derivation.

In First Order Logic:

\[ D2(x) \Rightarrow D11(x) \]

Properties:

L1 digitized (was digitized by): E18 Physical Thing

L60 documents: E1 CRM Entity

D3 Formal Derivation

Subclass of:

D10 Software Execution

Scope note:
This class comprises events that result in the creation of a D1 Digital Object from another one following a deterministic algorithm, such that the resulting instance of digital object shares representative properties with the original object.

In other words, this class describes the transition from an immaterial object referred to by property L21 used as derivation source (was derivation source for) to another immaterial object referred to by property L22 created derivative (was derivative created by) preserving the representation of some things but in a different form. Characteristic examples are colour corrections, contrast changes and resizing of images.

**In First Order Logic:**

\[ D3(x) \Rightarrow D10(x) \]

**Properties:**

- L21 used as derivation source (was derivation source for): D1 Digital Object
- L22 created derivative (was derivative created by): D1 Digital Object

**D7 Digital Machine Event**

**Subclass of:**

- E11 Modification
- E65 Creation

**Superclass of:**

- D10 Software Execution
- D11 Digital Measurement Event
- D12 Data Transfer Event

**Scope note:**

This class comprises events that happen on physical digital devices following a human activity that intentionally caused its immediate or delayed initiation and results in the creation of a new instance of D1 Digital Object on behalf of the human actor.

The input of a D7 Digital Machine Event may be parameter settings and/or data to be processed. Some D7 Digital Machine Events may form part of a wider E65 Creation event. In this case, all machine output of the partial events is regarded as creation of the overall activity.

**In First Order Logic:**

\[ D7(x) \Rightarrow E11(x) \]
\[ D7(x) \Rightarrow E65(x) \]

**Properties:**

- L10 had input (was input of): D1 Digital Object
- L11 had output (was output of): D1 Digital Object
- L12 happened on device (was device for): D8 Digital Device
- L18 has modified (was modified by): D13 Digital Information Carrier
- L23 used software or firmware (was software or firmware used by): D14 Software

**D8 Digital Device**

**Subclass of:**

E22 Human-Made Object

**Scope note:**

This class comprises identifiable material items such as computers, scanners, cameras, etc. that have the capability to process or produce instances of D1 Digital Object.

**In First Order Logic:**

\[ D8(x) \Rightarrow E22(x) \]

**D9 Data Object**

**Subclass of:**

- D1 Digital Object
- E54 Dimension

**Scope note:**

This class comprises instances of D1 Digital Object that are the direct result of a digital measurement or a formal derivative of it, containing quantitative properties of some physical things or other constellations of matter.

**In First Order Logic:**
D9(x) ⇒ D1(x)
D9(x) ⇒ E54(x)

D10 Software Execution

Subclass of:
D7 Digital Machine Event

Superclass of:
D3 Formal Derivation

Scope note:
This class comprises events by which a digital device runs a software program or a series of
computing operations on a digital object as a single task, which is completely determined by its
digital input, the software and the generic properties of the device.

In First Order Logic:
D10(x) ⇒ D7(x)

Properties:
L2 used as source (was source for): D1 Digital Object
L13 used parameters (parameters for): D1 Digital Object
L24 created logfile (was logfile created by): D1 Digital Object

D11 Digital Measurement Event

Subclass of:
D7 Digital Machine Event
E16 Measurement

Superclass of:
D2 Digitization Process
Scope note:
This class comprises actions measuring physical properties using a digital device, that are
determined by a systematic procedure and creates an instance of D9 Data Object, which is stored
on an instance of D13 Digital Information Carrier.

In contrast to instances of D10 Software Execution, environmental factors have an intended
influence on the outcome of an instance of D11 Digital Measurement Event.

Measurement devices may include running distinct software, such as the RAW to JPEG
conversion in digital cameras.

In this case, the event is regarded as instance of both classes, D10 Software Execution and D11
Digital Measurement Event.

In First Order Logic:
\[ D11(x) \Rightarrow D7(x) \]
\[ D11(x) \Rightarrow E16(x) \]

Properties:
L17 measured thing of type (was type of thing measured by): E55 Type
L20 has created (was created by): D9 Data Object

D12 Data Transfer Event

Subclass of:
D7 Digital Machine Event

Scope note:
This class comprises events that transfer a digital object from one digital carrier to another.
Normally, the digital object remains the same. If in general or by observation the transfer implies
or has implied some data corruption, the change of the digital objects may be documented
distinguishing input and output rather than instantiating the property L14 transferred (was
transferred by).

In First Order Logic:
\[ D12(x) \Rightarrow D7(x) \]

Properties:
L14 transferred (was transferred by): D1 Digital Object
L15 has sender (was sender for): D8 Digital Device
L16 has receiver (was sender for): D8 Digital Device

**D13 Digital Information Carrier**

Subclass of:

E1 CRM Entity

Scope note:

This class comprises all instances of E84 Information Carrier that are explicitly designed to be used as persistent digital physical carriers of instances of D1 Digital Object. A D13 Digital Information Carrier may or may not contain information, e.g., an empty diskette.

In First Order Logic:

\[ D13(x) \Rightarrow E1(x) \]

Properties:

L19 stores (is stored on): D1 Digital Object

**D14 Software**

Subclass of:

D1 Digital Object

Scope note:

This class comprises software codes, computer programs, procedures and functions that are used to operate a system of digital objects.

In First Order Logic:

\[ D14(x) \Rightarrow D1(x) \]
D29 Annotation Object

Subclass of:

E89 Propositional Object

Scope note:

This class comprises objects that make propositions about other artefacts. Instances of this class are not the attributes themselves, by which things are annotated, but represent the connection between the concepts related in a proposition, and the activities of creation, modification and deletion. This class is specialized by appropriate subclasses to express more specific relationships between annotated things, such as knowledge object, same as etc.

In First Order Logic:

D29(x) ⇒ E89(x)

Properties:

L43 annotates (is annotated by): E1 CRM Entity

D30 Annotation Event

Subclass of:

E65 Creation

Scope note:

This class comprises events that describe the creation of associations (â€œAnnotation Objectsâ€•) between objects or areas of objects of the Repository, with other objects or regions or persons, places, events. It is the event that creates the Annotation Object.

In First Order Logic:

D30(x) ⇒ E65(x)

Properties:

L48 created annotation (was annotation created by): D29 Annotation Object
D35 Area

Subclass of:

D1 Digital Object
E26 Physical Feature

Scope note:

This class describes a part (of any shape or size) of interest in basically any media object stored in the Object Repository, i.e., a text, an image, a video or a 3D model. It points to content consisting of just a portion or area of a file. In some contexts, however, the area can also point to content represented by an integral (i.e., proper) file. It is equal to the METS AREA element.

In First Order Logic:

D35(x) ⇒ D1(x)
D35(x) ⇒ E26(x)

Properties:

L49 is primary area of (has primary area): D1 Digital Object
L50 is propagated area of (has propagated area): D1 Digital Object
L1 digitized (was digitized by)

**Domain:**

D2 Digitization Process

**Range:**

E18 Physical Thing

**Subproperty of:**

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

**Scope note:**

This property associates an instance of D2 Digitization Process with an instance of E18 Physical Thing which is a material thing.

**In First Order Logic:**

\[ L1(x,y) \Rightarrow D2(x) \]
\[ L1(x,y) \Rightarrow E18(y) \]
\[ L1(x,y) \Rightarrow P39(x,y) \]
L2 used as source (was source for)

Domain:
D10 Software Execution

Range:
D1 Digital Object

Subproperty of:
D7 Digital Machine Event:L10 had input (was input of):D1 Digital Object

Scope note:
This property associates an instance of D10 Software Execution with an instance of D1 Digital Object which is used as a source, software essential for the performance.

In First Order Logic:
\[
\begin{align*}
L2(x,y) & \Rightarrow D10(x) \\
L2(x,y) & \Rightarrow D1(y) \\
L2(x,y) & \Rightarrow L10(x,y)
\end{align*}
\]

L10 had input (was input of)

Domain:
D7 Digital Machine Event

Range:
D1 Digital Object

Subproperty of:
E7 Activity:P16 used specific object (was used for):E70 Thing

Scope note:
This property associates an instance of D7 Digital Machine Event with an instance of D1 Digital Object which is the input used to specify the machine action.
In First Order Logic:

\[ L_{10}(x,y) \Rightarrow D_7(x) \]
\[ L_{10}(x,y) \Rightarrow D_1(y) \]
\[ L_{10}(x,y) \Rightarrow P_{16}(x,y) \]

**L11 had output (was output of)**

**Domain:**

D7 Digital Machine Event

**Range:**

D1 Digital Object

**Subproperty of:**

E65 Creation:P94 has created (was created by):E28 Conceptual Object

**Scope note:**

This property associates an instance of D7 Digital Machine Event with an instance of D1 Digital Object which is the output of the activity.

In First Order Logic:

\[ L_{11}(x,y) \Rightarrow D_7(x) \]
\[ L_{11}(x,y) \Rightarrow D_1(y) \]
\[ L_{11}(x,y) \Rightarrow P_{94}(x,y) \]

**L12 happened on device (was device for)**

**Domain:**

D7 Digital Machine Event

**Range:**

D8 Digital Device
**Subproperty of:**

E5 Event:P12 occurred in the presence of (was present at):E77 Persistent Item

**Scope note:**

This property associates an instance of D7 Digital Machine Event with an object, the D8 Digital Device, which happened with, e.g a capturing event that happened on/with a digital camera, etc.

**In First Order Logic:**

\[ L12(x,y) \Rightarrow D7(x) \]
\[ L12(x,y) \Rightarrow D8(y) \]
\[ L12(x,y) \Rightarrow P12(x,y) \]

**L13 used parameters (parameters for)**

**Domain:**

D10 Software Execution

**Range:**

D1 Digital Object

**Subproperty of:**

D7 Digital Machine Event:L10 had input (was input of):D1 Digital Object

**Scope note:**

This property associates an instance of D10 Software Execution with a digital object used as a parameter during the process.

**In First Order Logic:**

\[ L13(x,y) \Rightarrow D10(x) \]
\[ L13(x,y) \Rightarrow D1(y) \]
\[ L13(x,y) \Rightarrow L10(x,y) \]

**L14 transferred (was transferred by)**
Domain:

D12 Data Transfer Event

Range:

D1 Digital Object

Subproperty of:

D7 Digital Machine Event:L10 had input (was input of):D1 Digital Object

Scope note:

This property identifies a digital object transferred by a D12 Data Transfer Event.

In First Order Logic:

L14(x,y) ⇒ D12(x)
L14(x,y) ⇒ D1(y)
L14(x,y) ⇒ L10(x,y)

L15 has sender (was sender for)

Domain:

D12 Data Transfer Event

Range:

D8 Digital Device

Subproperty of:

D7 Digital Machine Event:L12 happened on device (was device for):D8 Digital Device

Scope note:

This property identifies a digital device used as a medium on which data are transferred through a D12 Data Transfer Event.

In First Order Logic:

L15(x,y) ⇒ D12(x)
L16 has receiver (was sender for)

Domain:
D12 Data Transfer Event

Range:
D8 Digital Device

Subproperty of:
D7 Digital Machine Event:L12 happened on device (was device for):D8 Digital Device

Scope note:
This property identifies a digital device used as a medium to receive data through a D12 Data Transfer Event.

In First Order Logic:
L16(x,y) ⇒ D12(x)
L16(x,y) ⇒ D8(y)
L16(x,y) ⇒ L12(x,y)

L17 measured thing of type (was type of thing measured by)

Domain:
D11 Digital Measurement Event

Range:
E55 Type

Subproperty of:
E7 Activity:P125 used object of type (was type of object used in):E55 Type
Scope note:
This property associates an instance of D11 Digital Measurement Event with the instance of E55 Type of object to which it applied.

In First Order Logic:
\[ L17(x,y) \Rightarrow D11(x) \]
\[ L17(x,y) \Rightarrow E55(y) \]
\[ L17(x,y) \Rightarrow P125(x,y) \]

L18 has modified (was modified by)

Domain:
D7 Digital Machine Event

Range:
D13 Digital Information Carrier

Subproperty of:
E11 Modification: P31 has modified (was modified by): E18 Physical Thing

Scope note:
This property identifies a Digital Information Carrier modified in a Digital Machine Event.

In First Order Logic:
\[ L18(x,y) \Rightarrow D7(x) \]
\[ L18(x,y) \Rightarrow D13(y) \]
\[ L18(x,y) \Rightarrow P31(x,y) \]

L19 stores (is stored on)

Domain:
D13 Digital Information Carrier

Range:
D1 Digital Object

Subproperty of:

E18 Physical Thing:P128 carries (is carried by):E90 Symbolic Object

Scope note:

This property associates an instance of a D13 Digital Information Carrier with the instance of Digital Object that is stored on it.

In First Order Logic:

\[
L_{19}(x,y) \Rightarrow D_{13}(x)
\]
\[
L_{19}(x,y) \Rightarrow D_{1}(y)
\]
\[
L_{19}(x,y) \Rightarrow P_{128}(x,y)
\]

L20 has created (was created by)

Domain:

D11 Digital Measurement Event

Range:

D9 Data Object

Subproperty of:

D7 Digital Machine Event:L11 had output (was output of):D1 Digital Object

Scope note:

This property identifies a Data Object that came into existence as a result of a D11 Digital Measurement Event.

In First Order Logic:

\[
L_{20}(x,y) \Rightarrow D_{11}(x)
\]
\[
L_{20}(x,y) \Rightarrow D_{9}(y)
\]
\[
L_{20}(x,y) \Rightarrow L_{11}(x,y)
\]
L21 used as derivation source (was derivation source for)

Domain:
D3 Formal Derivation

Range:
D1 Digital Object

Subproperty of:
D10 Software Execution:L2 used as source (was source for):D1 Digital Object

Scope note:
This property associates an instance of a D3 Formal Derivation with the instance of D1 Digital Object that is used as a derivation source.

In First Order Logic:
\[
L21(x, y) \Rightarrow D3(x) \\
L21(x, y) \Rightarrow D1(y) \\
L21(x, y) \Rightarrow L2(x, y)
\]

L22 created derivative (was derivative created by)

Domain:
D3 Formal Derivation

Range:
D1 Digital Object

Subproperty of:
D7 Digital Machine Event:L11 had output (was output of):D1 Digital Object

Scope note:
This property associates an instance of D3 Formal Derivation with the Digital Object it used to create a version of.
In First Order Logic:

\[ L_{22}(x,y) \Rightarrow D_{3}(x) \]
\[ L_{22}(x,y) \Rightarrow D_{1}(y) \]
\[ L_{22}(x,y) \Rightarrow L_{11}(x,y) \]

**L23 used software or firmware (was software or firmware used by)**

**Domain:**

D7 Digital Machine Event

**Range:**

D14 Software

**Subproperty of:**

E7 Activity:P16 used specific object (was used for):E70 Thing

**Scope note:**

This property associates an instance of D7 Digital Machine Event with the instance of D14 Software that had used.

In First Order Logic:

\[ L_{23}(x,y) \Rightarrow D_{7}(x) \]
\[ L_{23}(x,y) \Rightarrow D_{14}(y) \]
\[ L_{23}(x,y) \Rightarrow P_{16}(x,y) \]

**L24 created logfile (was logfile created by)**

**Domain:**

D10 Software Execution

**Range:**

D1 Digital Object
Subproperty of:

D7 Digital Machine Event:L11 had output (was output of):D1 Digital Object

Scope note:

This property identifies the logfile that was created by a D10 Software Execution in order to record all the activities in the system.

In First Order Logic:

L24(x,y) ⇒ D10(x)
L24(x,y) ⇒ D1(y)
L24(x,y) ⇒ L11(x,y)

L43 annotates (is annotated by)

Domain:

D29 Annotation Object

Range:

E1 CRM Entity

Scope note:

This property describes the associations between objects or areas of objects of the RI, with other objects or regions or persons, places, events.

In First Order Logic:

L43(x,y) ⇒ D29(x)
L43(x,y) ⇒ E1(y)

L48 created annotation (was annotation created by)

Domain:

D30 Annotation Event
Range:

D29 Annotation Object

Subproperty of:

E65 Creation:P94 has created (was created by):E28 Conceptual Object

Scope note:

This property identifies the D29 Annotation Object (associations) that came into existence as a result of a D30 Annotation Event.

In First Order Logic:

\[ L48(x,y) \Rightarrow D30(x) \]
\[ L48(x,y) \Rightarrow D29(y) \]
\[ L48(x,y) \Rightarrow P94(x,y) \]

L49 is primary area of (has primary area)

Domain:

D35 Area

Range:

D1 Digital Object

Subproperty of:

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

Scope note:

This property describes the association between a particular area declared in an original digital object.

In First Order Logic:

\[ L49(x,y) \Rightarrow D35(x) \]
\[ L49(x,y) \Rightarrow D1(y) \]
\[ L49(x,y) \Rightarrow P106(x,y) \]
L50 is propagated area of (has propagated area)

Domain:

D35 Area

Range:

D1 Digital Object

Subproperty of:

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

Scope note:

This property describes the association between an area and the digital object to which it is propagated.

In First Order Logic:

\[ L50(x,y) \Rightarrow D35(x) \]
\[ L50(x,y) \Rightarrow D1(y) \]
\[ L50(x,y) \Rightarrow P106(x,y) \]

L54 is same-as (is same-as)

Domain:

E1 CRM Entity

Range:

E1 CRM Entity

Scope note:

This property describes a non unique identification applied to E1 CRM Entity.

In First Order Logic:

\[ L54(x,y) \Rightarrow E1(x) \]
L60 documents

Domain:

D2 Digitization Process

Range:

E1 CRM Entity

Subproperty of:

E13 Attribute Assignment: P140 assigned attribute to (was attributed by): E1 CRM Entity

Scope note:

This property describes the CRM Entities documented by instances of Digitization Processes.

In First Order Logic:

L60(x,y) ⇒ D2(x)
L60(x,y) ⇒ E1(y)
L60(x,y) ⇒ P140(x,y)