INTERNATIONAL STANDARD

ISO/IEC 19763-3

Third edition
2020-10

Information technology — Metamodel framework for interoperability (MFI) —

Part 3:
Metamodel for ontology registration

Technologies de l'information — Cadre du métamodèle pour l'interopérabilité (MFI) —

Partie 3: Métamodèle pour l'enregistrement de l'ontologie

COPYRIGHT PROTECTED DOCUMENT

Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see http://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

This third edition cancels and replaces the second edition (ISO/IEC 19763-3:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— no direct inheritance from Administered Item of ISO/IEC 11179-3 in 5.2 and 5.4 to align with ISO/IEC 19763-10;

— clarification in 5.4 that "Ontology_Language", "Ontology_Whole", "Ontology_Component" and "Ontology_Atomic_Construct" are inherited from "Modelling_Language", "Model" or "Model_Element" of ISO/IEC 19763-10;

— changes of attribute and reference names in 5.4 and 5.5 to align with ISO/IEC 19763-10 (see Annex D);

— editorial changes throughout the document to fully align with ISO/IEC Directives Part 2.

A list of all parts in the ISO/IEC 19763 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Interoperability among heterogeneous application systems serves to improve business performance. To promote it, unambiguous and formal specifications of the systems, especially of their inputs and outputs, are indispensable. Ontologies have a key role for that.

Several efforts to establish standards associated with ontologies have been made. But, most of them specify languages or are based on some particular language. To promote ontology-based interoperability, in addition to them, a generic framework for registering administrative and evolution information related to ontologies, independent of languages, is necessary.

This document provides a generic framework for registering administrative and evolution information related to ontologies.

The metamodels of ontologies expressed in specific languages and the mappings among them are specified in other specifications such as Reference [1].

Figure 1 illustrates the MFI ontology registration specified in this document.
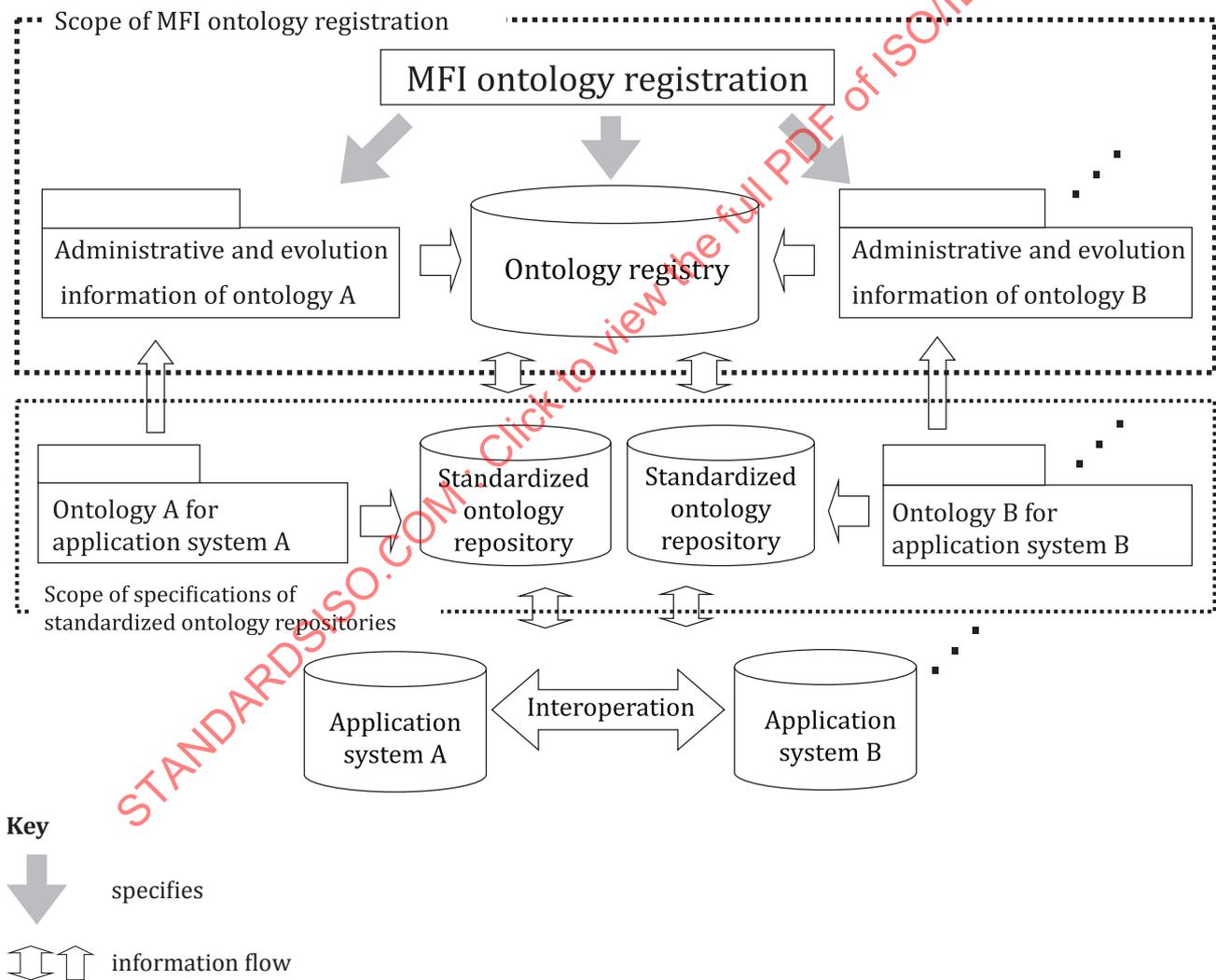
Figure 1 — MFI ontology registration

Information technology — Metamodel framework for interoperability (MFI) —

Part 3:
Metamodel for ontology registration

1   Scope

This document specifies the metamodel that provides a facility to register administrative and evolution information related to ontologies.

The metamodel is intended to promote interoperability among application systems, by providing administrative and evolution information related to ontologies, accompanied with standardized ontology repositories that register ontologies themselves in specific languages.

This document does not specify the metamodels of ontologies expressed in specific languages and the mappings among them.

2   Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 11179-3, *Information technology — Metadata registries (MDR) — Part 3: Registry metamodel and basic attributes*

ISO/IEC 19763-1, *Information technology — Metamodel framework for interoperability (MFI) — Part 1: Framework*

ISO/IEC 19763-10, *Information technology — Metamodel framework for interoperability (MFI) — Part 10: Core model and basic mapping*

3   Terms, definitions and abbreviated terms

3.1   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11179-3, ISO/IEC 19763-1 and ISO/IEC 19763-10 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1 Terms on ontology

3.1.1.1
ontology
specification of concrete or abstract things, and the relationships among them, in a prescribed domain of knowledge

Note 1 to entry: The specification should be computer processable.

3.1.1.2
reference registered ontology
ontology (3.1.1.1) that is registered in a registry that conforms to MFI ontology registration and that is usable and sharable by a community of interest

3.1.1.3
local registered ontology
ontology (3.1.1.1) that is registered in a registry that conforms to MFI ontology registration and that is specialized for defined applications

3.1.2 Other terms

3.1.2.1
sentence
statement that has a truth value

3.1.2.2
symbol
most primitive lexical construct that is a part of a *sentence* (3.1.2.1)

3.1.2.3
logical symbol
symbol (3.1.2.2) whose meaning is defined by its language

EXAMPLE   In KIF, "not" and "or" are logical symbols.

3.1.2.4
authoritative extent
extent that determines whether a thing can use another thing

Note 1 to entry: A thing can use another thing if and only if the authoritative extent of the former is less than or equal to the authoritative extent of the latter because the usage of the latter by the former does not affect the authoritative extent of the former since the authoritative level of the latter is greater than or equal to the one of the former.

EXAMPLE   A product with some authoritative extent can only use as its component a part with an authoritative extent which is greater than or equal to the one of it, to keep its authoritative extent.

Note 2 to entry: In this document, an authoritative extent is used to determine whether a Local_Item can consist of or use another Local_Item. See 5.5.2 Local_Item.

3.2 Abbreviated terms

IRI   internationalized resource identifier (see Reference [2])

KIF   knowledge interchange format (see Reference [3])

MDR   metadata registry

MFI   metamodel framework for interoperability

ODM   ontology definition metamodel (see Reference [1])

OWL   web ontology language (see Reference [4])

UML   unified modeling language (see Reference [12])

4 Conformance

4.1 General

An implementation claiming conformance to this document shall support one or both of the metamodels specified in this document and may or shall not support any extensions, depending on which level of conformance and which degree of conformance it claims.

4.2 Levels of conformance

4.2.1 General

An implementation may conform to either of the two levels of conformance to this document, depending on what packages it supports.

4.2.2 Conformance level 1

The metamodel specified in subclause 5.5 is supported.

4.2.3 Conformance level 2

The metamodels specified in subclauses 5.5 and 5.6 are supported.

4.3 Degree of conformance

4.3.1 General

In each conformance level, the distinction between "strictly conforming" and "conforming" implementations is necessary to address the simultaneous needs for interoperability and extensions. This document describes specifications that promote interoperability. Extensions are motivated by needs of users, vendors, institutions and industries, but are not specified by this document.

A strictly conforming implementation can be limited in usefulness but is maximally interoperable with respect to this document. A conforming implementation can be more useful but can be less interoperable with respect to this document.

4.3.2 Strictly conforming implementation

A strictly conforming implementation for some conformance level:

a) shall support the metamodels required in the conformance level;

b) shall not support any extensions to the metamodels required in the conformance level.

4.3.3 Conforming implementation

A conforming implementation:

a) shall support the metamodels required in the conformance level;

b) may support extensions to the metamodels required in the conformance level, and the extensions shall be consistent with the metamodels required in the conformance level.

4.4   Implementation conformance statement (ICS)

An implementation claiming conformance to this document shall include an implementation conformance statement stating:

a) which conformance level it claims (4.2);

b) whether it is a strictly conforming implementation or a conforming implementation (4.3);

c) what extensions are supported if it is a conforming implementation.

5   Structure of MFI ontology registration

5.1   Overview of MFI ontology registration

MFI ontology registration consists of two packages: Basic_Model package and Evolution_Model package. Figure 2 shows the package structure of MFI ontology registration.
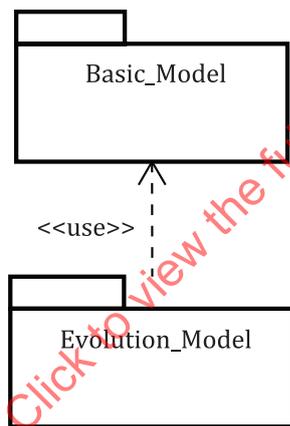
Figure 2 — Package structure of MFI ontology registration

The Basic_Model package is used to register administrative information related to ontologies, independently of the languages that are used to express them. The basic idea is that almost any ontology consists of several sentences and that each sentence uses several non-logical symbols. The metaclasses in Basic_Model package include Ontology_Whole, Ontology_Component and Ontology_Atomic_Construct, which have administrative information of ontologies, sentences and non-logical symbols respectively. Since an ontology evolves, Basic_Model package can register as many versions of an ontology as necessary. But, in Basic_Model package, each version of an ontology is treated as a different ontology.

The Evolution_Model package is used to register information on how an ontology evolves from one version to another. Evolution_Model package basically consists of three metaclasses, Registered_Ontology_Whole_Evolution, Registered_Ontology_Component_Evolution and Registered_Ontology_Atomic_Construct_Evolution, which have evolution information on Registered_Ontology_Whole, Registered_Ontology_Component and Registered_Ontology_Atomic_Construct respectively.

5.2   Overview of Basic_Model package

Figure 3 shows the metamodel in Basic_Model package.
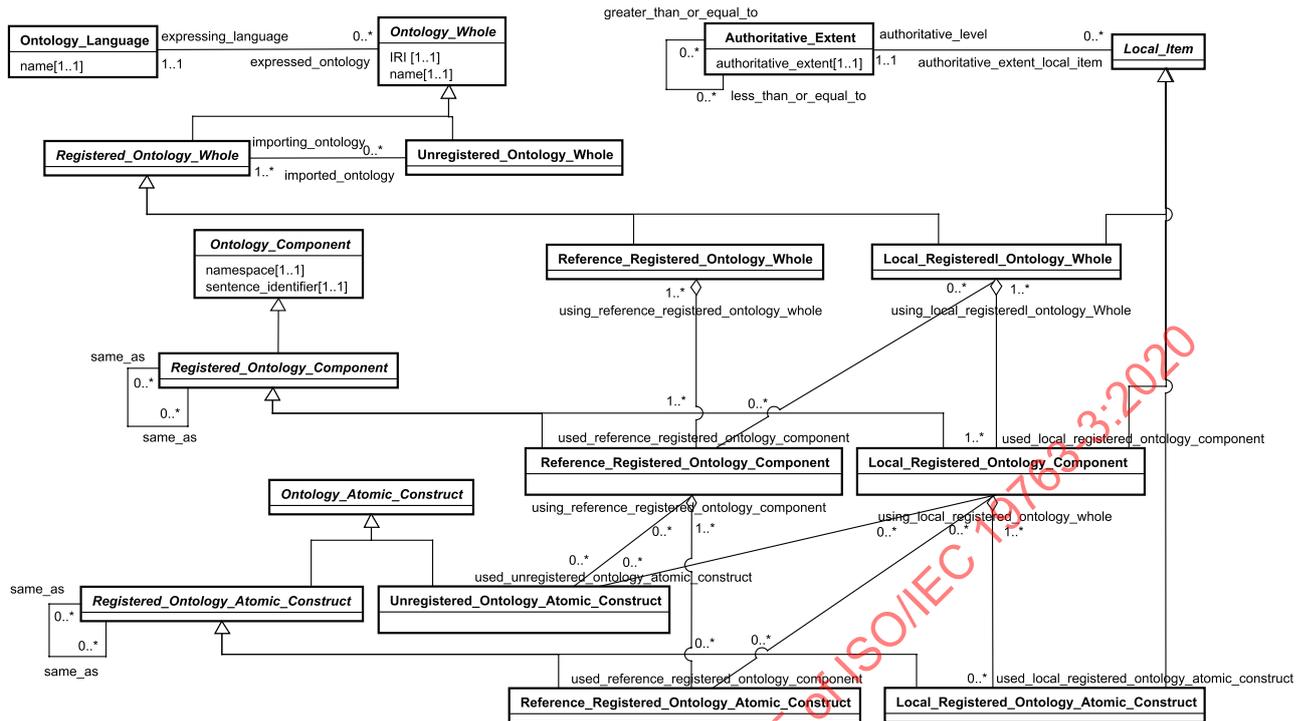
NOTE   Metaclasses whose names are italicized are abstract metaclasses.

Figure 3 — Metamodel in Basic_Model package

Ontology_Whole is an abstract metaclass that represents an ontology and contains the associated administrative information. Ontology_Language is used as the reference "expressing_language" of Ontology_Whole to indicate a language that is used to express an ontology that is represented by Ontology_Whole. Ontology_Component is an abstract metaclass that represents a sentence contained in ontologies and contains the associated administrative information. The granularity of a sentence is not specified but is a user's choice. Ontology_Atomic_Construct is an abstract metaclass that represents a non-logical symbol that is used in sentences and contains the associated administrative information.

Ontology_Whole has two direct subclasses, Registered_Ontology_Whole and Unregistered_Ontology_Whole. Registered_Ontology_Whole is an abstract metaclass that represents an ontology that is registered in a registry that conforms to MFI ontology registration. Unregistered_Ontology_Whole is a metaclass that represents an ontology that is not registered but imported by an ontology that is registered in a registry that conforms to MFI ontology registration.

Ontology_Component has only one direct subclass Registered_Ontology_Component. Registered_Ontology_Component is an abstract metaclass that represents an ontology that is registered in a registry that conforms to MFI ontology registration. Any instance of Ontology_Component is a Registered_Ontology_Component since a sentence that is not registered in a registry that conforms to MFI ontology registration is out of scope.

Similar to Ontology_Whole, Ontology_Atomic_Construct has two direct subclasses, Registered_Ontology_Atomic_Construct and Unregistered_Ontology_Atomic_Construct. Registered_Ontology_Atomic_Construct is an abstract metaclass that represents a non-logical symbol that is registered in a registry that conforms to MFI ontology registration. Unregistered_Ontology_Atomic_Construct is a metaclass that represents a non-logical symbol that is not registered but used by a sentence that is registered in a registry that conforms to MFI ontology registration.

Registered_Ontology_Whole has two direct subclasses, Reference_Registered_Ontology_Whole and Local_Registered_Ontology_Whole. Reference_Registered_Ontology_Whole represents a reference registered ontology and Local_Registered_Ontology_Whole represents a local registered ontology.

Similarly, Registered_Ontology_Component has two direct subclasses, Reference_Registered_Ontology_ Component and Local_Registered_Ontology_Component. Reference_Registered_Ontology_Component represents a sentence contained in ontologies that are represented by Reference_Registered_Ontology_ Whole. Local_Registered_Ontology_Component represents a sentence contained in ontologies that are represented by Local_Registered_Ontology_Whole. A sentence that is represented by Reference_Registered_Ontology_Component may also be contained in ontologies that are represented by Local_Registered_Ontology_Whole, but a sentence that is represented by Local_Registered_ Ontology_Component cannot be contained in ontologies that are represented by Reference_Registered_ Ontology_Whole.

Similarly, Registered_Ontology_Atomic_Construct also has two direct subclasses, Reference_ Registered_Ontology_Atomic_Construct and Local_Registered_Ontology_Atomic_Construct. Reference_Registered_Ontology_Atomic_Construct represents a non-logical symbol that is used in sentences that are represented by Reference_Registered_Ontology_Component. Local_Registered_ Ontology_Atomic_Construct represents a non-logical symbol that is used in sentences that are represented by Local_Registered_Ontology_Component. A non-logical symbol that is represented by Reference_Registered_Ontology_Atomic_Construct may also be used in sentences that are represented by Local_Registered_Ontology_Component, but a non-logical symbol that is represented by Local_ Registered_Ontology_Atomic_Construct cannot be used in sentences that are represented by Reference_ Registered_Ontology_Component.

Local_Item is an abstract metaclass that is a collectively exhaustive superclass of Local_Registered_ Ontology_Whole, Local_Registered_Ontology_Component and Local_Registered_Ontology_Atomic_ Construct. Authoritative_Extent is used as the reference "authoritative_level" of Local_Item to indicate whether a Local_Item can consist of or use another Local_Item. A sentence that is represented by Local_Registered_Ontology_Component may also be contained in ontologies that are represented by Local_Registered_Ontology_Whole whose value of "authoritative_level" is less than or equal to the value of "authoritative_level" of this Local_Registered_Ontology_Component. A non-logical symbol that is represented by Local_Registered_Ontology_Atomic_Construct may also be used in sentences that are represented by Local_Registered_Ontology_Component whose value of "authoritative_level" is less than or equal to the value of "authoritative_level" of this Local_Registered_Ontology_Atomic_Construct.

The exact specification of each metaclass in Basic_Model package is given in subclause 5.5. Annex B shows how each metaclass in Basic_Model package is used for registering administrative information related to ontologies.

5.3 Overview of Evolution_Model package

Figure 4 shows the metamodel in Evolution_Model package.

Item_Evolution is an abstract metaclass that is a collectively exhaustive superclass of Registered_ Ontology_Whole_Evolution, Registered_Ontology_Component_Evolution and Registered_Ontology_ Atomic_Construct_Evolution. Registered_Ontology_Whole_Evolution is a metaclass that indicates what a Registered_Ontology_Whole evolves to and is possibly composed of Registered_Ontology_Component_ Evolution. Registered_Ontology_Component_Evolution is a metaclass that indicates what a Registered_ Ontology_Component evolves to and is possibly composed of Registered_Ontology_Atomic_Construct_ Evolution. Registered_Ontology_Atomic_Construct_Evolution is a metaclass that indicates what a Registered_Ontology_Atomic_Construct evolves to. Evolution information on Unregistered_Ontology_ Whole and Unregistered_Ontology_Atomic_Construct is out of scope since they are not registered.

The exact specification of each metaclass in Evolution_Model package is given in subclause 5.6. Annex C shows how each metaclass in Evolution_Model package is used for registering information on how an ontology evolves from one version to another.
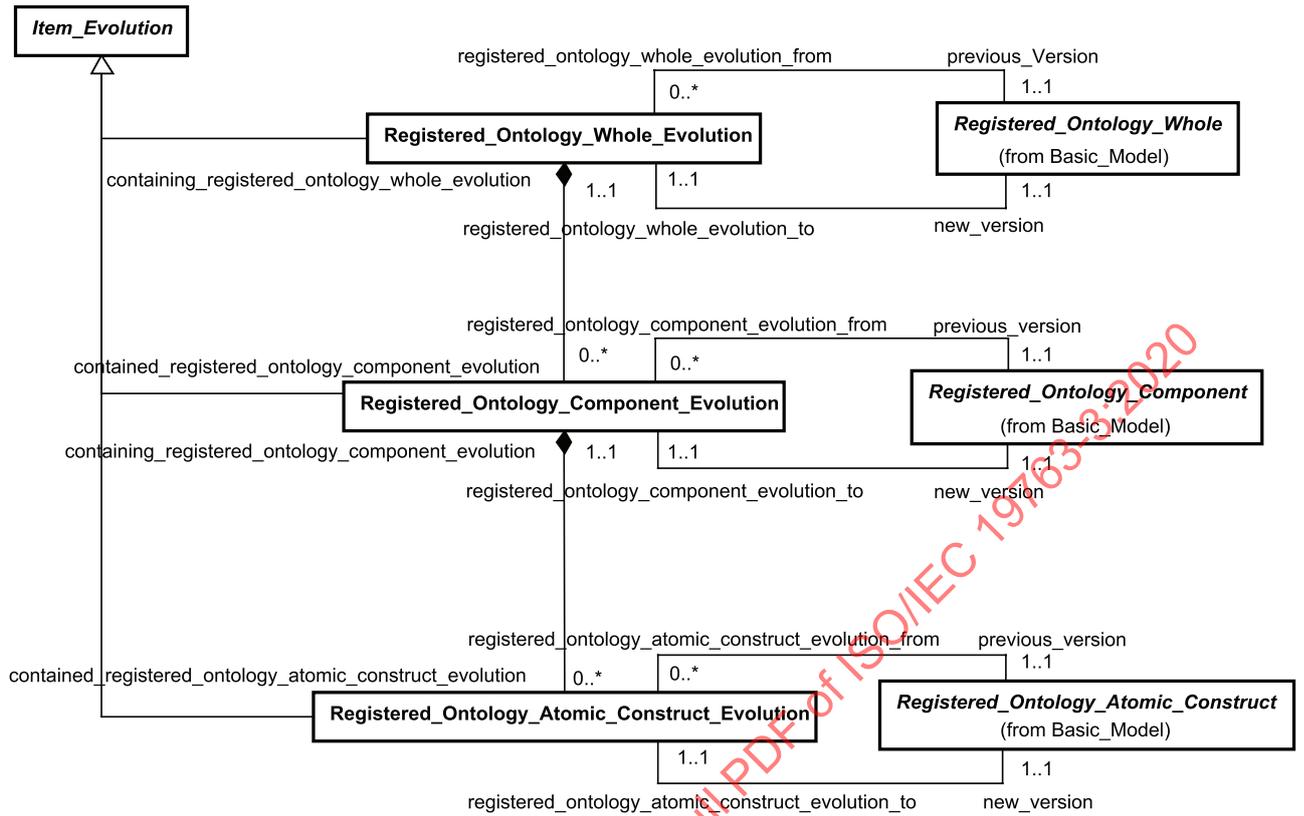
NOTE   Metaclasses whose names are italicized are abstract metaclasses.

Figure 4 — Metamodel in Evolution_Model package

5.4   Association between MFI ontology registration and MFI core and mapping

The associations between the metaclasses in MFI ontology registration and the metaclasses in MFI core and mapping are shown in Figure 5.
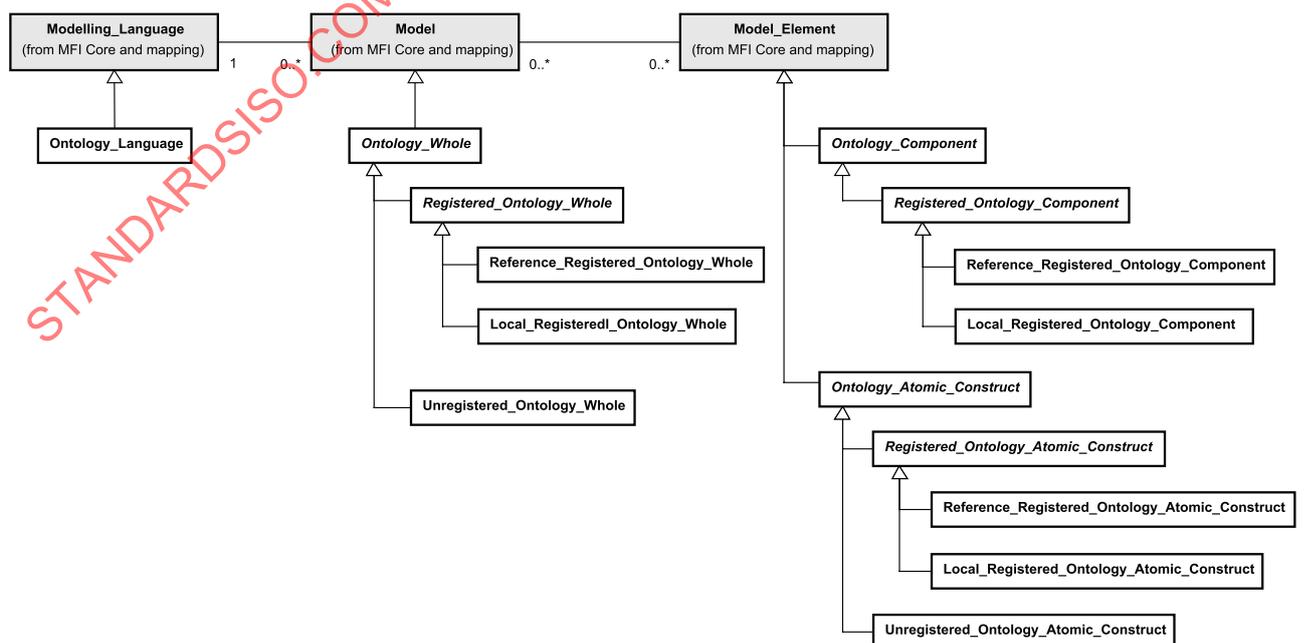
Figure 5 — The associations between MFI ontology registration and MFI core and mapping

5.5   Basic_Model package

5.5.1   Authoritative_Extent

Authoritative_Extent is a metaclass each instance of which represents authoritative extent and composes a partially ordered set in terms of the reference "less_than_or_equal_to".

Superclass

[None]

Attribute	DataType	Multiplicity	Description		
authoritative_extent	String	1..1	The string represents the authoritative extent of this Authoritative_Extent		

Reference	Class	Multiplicity	Description	Inverse	Precedence
less_than_or_equal_to	Authoritative_Extent	0..*	The set of authoritative_extents that this authoritative_extent is less than or equal to	greater_than_or_equal_to	Yes
authoritative_extent_local_item	Local_Item	0..*	The set of instances of Local_Item, each authoritative level of which is this Authoritative_Extent	authoritative_level	No
greater_than_or_equal_to	Authoritative_Extent	0..*	The set of authoritative_extents that this authoritative_extent is greater than or equal to	less_than_or_equal_to	No

Constraints

The value of the attribute "authoritative_extent" shall be unique in this metaclass.

NOTE   Authoritative_Extent is used by Local_Item. See NOTE in subclause 5.5.2.

5.5.2   Local_Item

Local_Item is an abstract metaclass that is a collectively exhaustive superclass of Local_Registered_Ontology_Whole, Local_Registered_Ontology_Component and Local_Registered_Ontology_Atomic_Construct.

Superclass

[None]

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
authoritative_level	Authoritative_Extent	1..1	The authoritative extent of this Local_Item	authoritative_extent_local_item	Yes

Constraints

[None]

NOTE   Local_Item X can consist of or use Local_Item Y if and only if the authoritative_level of X is less than or equal to the authoritative_level of Y. For more details, see constraints in subclauses 5.5.8 and 5.5.12.

5.5.3 Ontology_Language

Ontology_Language is a metaclass each instance of which represents an ontology expression language.

Superclass

Modelling_Language (from MFI Core and mapping)

Attribute	DataType	Multiplicity	Description		
name	String	1..1	A name of the ontology expression language.		

Reference	Class	Multiplicity	Description	Inverse	Precedence
expressed_ontology	Ontology_Whole	0..*	The set of ontologies expressed by this ontology language	expressing_language	No

Constraints

The value of the attribute "name" shall be unique in this metaclass.

NOTE   Annex A suggests a means of deciding the value of the attribute.

5.5.4 Ontology_Whole

Ontology_Whole is an abstract metaclass that is a collectively exhaustive superclass of Registered_Ontology_Whole and Unregistered_Ontology_Whole.

Superclass

Model (from MFI Core and mapping)

Attribute	DataType	Multiplicity	Description		
IRI	String	1..1	An IRI that identifies the corresponding ontology		
name	String	1..1	A name of the corresponding ontology		

Reference	Class	Multiplicity	Description	Inverse	Precedence
expressing_language	Ontology_Language	1..1	The ontology expression language that is used to express the corresponding ontology	Authoritative_extent_local_item	Yes

Constraints

The value of the attribute "IRI" shall be unique in this metaclass.

5.5.5 Registered_Ontology_Whole

Registered_Ontology_Whole is an abstract metaclass that is a collectively exhaustive superclass of Reference_Registered_Ontology_Whole and Local_Registered_Ontology_Whole.

Superclass

Ontology_Whole

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
imported_ontology	Unregistered_Ontology_Whole	0..*	The set of instances of Unregistered_Ontology_Whole each of which represents an unregistered ontology that is imported by the corresponding ontology	importing_ontology	Yes

registered_ ontology_ whole_ evolution_ from	Registered_ Ontology_ Whole_ Evolution	0..*	The set of instances of Registered_Ontology_Whole_ Evolution each of which represents information on the evolution from the corresponding ontology	previous_ version	No
registered_ ontology_ whole_ evolution_ to	Registered_ Ontology_ Whole_ Evolution	1..1	The instance of Registered_ Ontology_Whole_Evolution that represents information on the evolution to the corresponding ontology	new_ version	No

Constraints

[None]

5.5.6   Unregistered_Ontology_Whole

Unregistered_Ontology_Whole is a metaclass each instance of which represents an ontology that is not registered but imported by an ontology that is registered in a registry that conforms to MFI ontology registration.

Superclass

Ontology_Whole

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
importing_ ontology	Registered_ Ontology_ Whole	1..*	The set of instances of Registered_Ontology_Whole each of which represents registered ontology that imports the corresponding unregistered ontology	imported_ ontology	No

Constraints

[None]

5.5.7   Reference_Registered_Ontology_Whole

Reference_Registered_Ontology_Whole is a metaclass each instance of which represents a reference registered ontology.

Superclass

Registered_Ontology_Whole

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
used_ reference_ registered_ ontology_ component	Reference_ Registered_ Ontology_ Component	1..*	The set of instances of Reference_Registered_ Ontology_Component each of which represents the sentence contained in the ontology represented by this Reference_ Registered_Ontology_Whole	using_ reference_ registered_ ontology_ whole	Yes

Constraints

[None]

5.5.8 Local_Registered_Ontology_Whole

Local_Registered_Ontology_Whole is a metaclass each instance of which represents a local registered ontology.

Superclass

Registered_Ontology_Whole, Local_Item

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
used_ reference_ registered_ ontology_ component	Reference_ Registered_ Ontology_ Component	0..*	The set of instances of Reference_Registered_ Ontology_Component each of which represents the sentence contained in the ontology represented by this Reference_Registered_ Ontology_Whole	using_local_ registered_ ontology_ whole	Yes
used_local_ registered_ ontology_ component	Local_ Registered_ Ontology_ Component	1..*	The set of instances of Local_ Registered_Ontology_Component each of which represents the sentence contained in the ontology represented by this Reference_Registered_ Ontology_Whole	using_local_ registered_ ontology_ whole	Yes

Constraints

The value of the attribute "authoritative_level" (inherited from Local_Item) of this Local_Registered_Ontology_Whole shall be "less_than_or_equal_to" the value of the attribute "authoritative_level" (inherited from Local_Item) of the Local_Registered_Ontology_Component that is the value of the reference "used_local_registered_ontology_ component" of this Local_Registered_Ontology_Whole.

NOTE   It is a good practice that a Local_Registered_Ontology_Whole consists of some Reference_Registered_ Ontology_Components as it evolves.

5.5.9 Ontology_Component

Ontology_Component is an abstract metaclass that is a collectively exhaustive superclass of Registered_ Ontology_Component.

Superclass

Model_Element (from MFI Core and mapping)

Attribute	DataType	Multiplicity	Description
namespace	String	1..1	An IRI where the value of the sentenceIdentifier is uniquely identified
sentence_identifier	String	1..1	An identifier of the corresponding sentence within the namespace

Reference	Class	Multiplicity	Description	Inverse	Precedence
[None]					

Constraints

a) The value of the attribute "sentence_identifier" prefixed by the value of the attribute "namespace" shall be unique in this metaclass.

b) The value of the attribute "sentence_identifier" prefixed by the value of the attribute "namespace" shall identify the corresponding sentence.

5.5.10 Registered_Ontology_Component

Registered_Ontology_Component is an abstract metaclass representing a sentence contained in an ontology that is represented by Registered_Ontology_Whole. Granularity of a sentence is not specified in this document.

Superclass

Ontology_Component

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
same_as	Registered_ Ontology_ Component	0..*	The set of instances of Registered_Ontology_ Component each of which represents the sentence that is interpreted exactly the same as the sentence represented by this Registered_Ontology_ Component	same_as	Yes
registered_ ontology_ component _evolution_ from	Registered_ Ontology_ Component_ Evolution	0..*	The set of instances of Registered_Ontology_ Component_Evolution each of which represents information on the evolution from the sentence represented by this Registered_ Ontology_Component	previous_ version	No
registered_ ontology_ component _evolution_ to	Registered_ Ontology_ Component_ Evolution	1..1	The instance of Registered_ Ontology_Component_ Evolution that represents information on the evolution to the sentence represented by this Registered_Ontology_Component	new_ version	No

Constraints

[None]

5.5.11 Reference_Registered_Ontology_Component

Reference_Registered_Ontology_Component is a metaclass each instance of which represents a sentence contained in an ontology that is represented by an instance of Reference_Registered_Ontology_Whole.

Superclass

Registered_Ontology_Component

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
used_ unregistred_ ontology_ atomic_ construct	Unregistered_ Ontology_ Atomic_ Construct	0..*	The set of instances Unregistered_Ontology_ Atomic_Constructs, each of which represents the non-logical symbol that is used in the sentence represented by this Reference_Registered_ Ontology_Component	using_ reference_ registered_ ontology_ component	Yes

Reference	Class	Multiplicity	Description	Inverse	Precedence
used_reference_registered_ontology_atomic_construct	Reference_Registered_Ontology_Atomic_Construct	0..*	The set of instances of Reference_Registered_Ontology_Atomic_Constructs, each of which represents the non-logical symbol that is used in the sentence represented by this Reference_Registered_Ontology_Component	using_reference_registered_ontology_component	Yes
using_reference_registered_ontology_whole	Reference_Registered_Ontology_Whole	1..*	The set of instances of Reference_Registered_Ontology_Component each of which represents the sentence contained in the ontology represented by this Reference_Registered_Ontology_Whole	used_reference_registered_ontology_component	No
using_local_registered_ontology_whole	Local_Registered_Ontology_Whole	0..*	The set of instances of Local_Registered_Ontology_Whole each of which represents a local registered ontology that uses a sentence represented by this Reference_Registered_Ontology_Component	used_local_registered_ontology_component	No

Constraints

The range of the attribute "same_as" (inherited from Registered_Ontology_Component) shall be within Reference_Registered_Ontology_Component.

5.5.12 Local_Registered_Ontology_Component

Local_Registered_Ontology_Component is a metaclass each instance of which represents a sentence contained in an ontology that is represented by an instance of Local_Registered_Ontology_Whole.

Superclass

Registered_Ontology_Component, Local_Item

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
used_unregistered_ontology_atomic_construct	Unregistered_Ontology_Atomic_Construct	0..*	The set of instances of Unregistered_Ontology_Atomic_Constructs each of which represents the non-logical symbol that is used in the sentence represented by this Local_Registered_Ontology_Component	using_local_registered_ontology_component	Yes
used_reference_registered_ontology_atomic_construct	Reference_Registered_Ontology_Atomic_Construct	0..*	The set of instances of Reference_Registered_Ontology_Atomic_Construct each of which represents the non-logical symbol that is used in the sentence represented by this Local_Registered_Ontology_Component	using_local_registered_ontology_component	Yes

| used_local_ registered_ ontology_ atomic_ construct | Local_ Registered_ Ontology_ Atomic_ Construct | 0..* | The set of instances of Local_ Registered_Ontology_Atomic_ Construct each of which represents the non-logical symbol that is used in the sentence represented by this Local_ Registered_Ontology_Component | using_ local_ registered_ ontology_ component | Yes |
| using_local_ registered_ ontology_ whole | Local_ Registered_ Ontology_ Whole | 1..* | The set of instances of Local_ Registered_Ontology_Whole each of which represents the local registered ontology that uses the sentence represented by this Local_Registered_Ontology_ Component | used_ local_ registered_ ontology_ component | No |

Constraints

a)   The value of the attribute "authoritative_level" (inherited from Local_Item) of this Local_Registered_ Ontology_Component shall be "less_than_or_equal_to" the value of the attribute "authoritative_level" (inherited from Local_Item) of the Local_Registered_Ontology_Atomic_Construct that is the value of the reference "used_local_registered_ontology_atomic_construct" of this Local_Registered_Ontology_ Component.

b)   If a value of the attribute "same_as" (inherited from Registered_Ontology_Component) of this Local_ Registered_Ontology_Component is an instance of Local_Registered_Ontology_Component, the value of the attribute "authoritative_level" (inherited from Local_Item) of this Local_Registered_Ontology_Component shall be "less_than_or_equal_to" the value of the attribute "authoritative_level" (inherited from Local_Item) of the instance of Local_Registered_Ontology_Component.

NOTE   It is good practice that a Local_Registered_Ontology_Component uses some Reference_Registered_ Ontology_Atomic_Constructs as it evolves.

5.5.13   Ontology_Atomic_Construct

Ontology_Atomic_Construct is an abstract metaclass that is a collectively exhaustive superclass of Registered_Ontology_Atomic_Construct and Unregistered_Ontology_Atomic_Construct.

Superclass

Model_Element (from MFI Core and mapping)

Attribute	DataType	Multiplicity	Description
namespace	String	1..1	IRI where the corresponding non-logical symbol is uniquely identified
non_logical_ symbol	String	1..1	The corresponding non-logical symbol

Reference	Class	Multiplicity	Description	Inverse	Precedence
[None]					

Constraints

The value of the attribute "non_logical_symbol" prefixed by the value of the attribute "namespace" shall be unique in this metaclass.

5.5.14   Registered_Ontology_Atomic_Construct

Registered_Ontology_Atomic_Construct is an abstract metaclass representing a non-logical symbol that is defined in a sentence that is represented by Registered_Ontology_Component.

Superclass

Ontology_Atomic_Construct

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
same_as	Registered_ Ontology_ Atomic_ Construct	0..*	The set of instances of Registered_Ontology_ Atomic_Construct each of which represents the sentence that is interpreted exactly the same as the sentence represented by this Registered_Ontology_Atomic_ Construct	same_as	Yes
registered_ ontology_ atomic_ construct_ evolution_ from	Registered_ Ontology_ Component_ Evolution	0..*	The set of instances of Registered_Ontology_Atomic_ Construct_Evolution each of which represents information on the evolution from the non-logical symbol represented by this Registered_Ontology_Atomic_ Construct	previous_ version	No
registered_ ontology_ atomic_ construct_ evolution_ to	Registered_ Ontology_ Component_ Evolution	1..1	The instance of Registered_ Ontology_Atomic_Construct_ Evolution that represents information on the evolution to the non-logical symbol represented by this Registered_ Ontology_Atomic_Construct	new_ version	No

Constraints

[None]

5.5.15 Unregistered_Ontology_Atomic_Construct

Unregistered_Ontology_Atomic_Construct is a metaclass each instance of which represents a non-logical symbol that is not defined but used in a sentence that is represented by Registered_Ontology_ Component.

Superclass

Ontology_Atomic_Construct

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
using_ reference_ registered_ ontology_ component	Reference_ Registered_ Ontology_ Component	0..*	The set of instances of Reference_Registered_ Ontology_Component each of which represents sentence that use the non-logical symbol represented by this Unregistered_Ontology_ Atomic_Construct	used_ unregistered_ ontology_ atomic_ construct	No
using_ local_ registered_ ontology_ component	Local_ Registered_ Ontology_ Component	0..*	The set of instances of Local_ Registered_Ontology_ Component each of which represents sentence that use the non-logical symbol represented by this Unregistered_Ontology_ Atomic_Construct	used_ unregistered_ ontology_ atomic_ construct	No

Constraints

[None]

5.5.16 Reference_Registered_Ontology_Atomic_Construct

Reference_Registered_Ontology_Atomic_Construct is a metaclass each instance of which represents a non-logical symbol that is defined in a sentence that is represented by an instance of Reference_ Registered_Ontology_Component.

Superclass

Registered_Ontology_Atomic_Construct

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
using_ reference_ registered_ ontology_ component	Reference_ Registered_ Ontology_ Component	1..*	The set of instances of Reference_Registered_ Ontology_Component each of which represents sentence that use the non-logical symbol represented by this Reference_Registered_ Ontology_Atomic_Construct	used_ reference_ registered_ ontology_ atomic_ construct	No
using_ local_ registered_ ontology_ component	Local_ Registered_ Ontology_ Component	0..*	The set of instances of Local_Registered_Ontology_ Component each of which represents sentence that use the non-logical symbol represented by this Reference_Registered_ Ontology_Atomic_Construct	used_ reference_ registered_ ontology_ atomic_ construct	No

Constraints

The range of the attribute "same_as" (inherited from Registered_Ontology_Atomic_Construct) shall be within Reference_Registered_Ontology_Atomic_Construct.

5.5.17 Local_Registered_Ontology_Atomic_Construct

Local_Registered_Ontology_Atomic_Construct is a metaclass each instance of which represents a non-logical symbol that is defined in a sentence that is represented by an instance of Local_Registered_ Ontology_Component.

Superclass

Registered_Ontology_Atomic_Construct, Local_Item

Attribute	DataType	Multiplicity	Description
[None]			

Reference	Class	Multiplicity	Description	Inverse	Precedence
using_ local_ registered_ ontology_ component	Local_ Registered_ Ontology_ Component	1..*	The set of instances of Local_ Registered_Ontology_ Component each of which represents sentence that use the non-logical symbol represented by this Local_Registered_Ontology_ Atomic_Construct	used_local_ registered_ ontology_ atomic_ construct	No

Constraints

If a value of the attribute "same_as" (inherited from Registered_Ontology_Atomic_Construct) of this Local_Registered_Ontology_Atomic_Construct is an instance of Local_Registered_Ontology_Atomic_Construct, the value of the attribute "authoritative_level" (inherited from Local_Item) of this Local_Registered_Ontology_Atomic_Construct shall be less than or equal to the value of the attribute "authoritative_level" (inherited from Local_Item) of the instance of Local_Registered_Ontology_Atomic_Construct.

5.6 Evolution_Model package

5.6.1 Item_Evolution

Item_Evolution is an abstract metaclass that is a collectively exhaustive superclass of Registered_ Ontology_Whole_Evolution, Registered_Ontology_Component_Evolution and Registered_Ontology_ Atomic_Construct_Evolution.

Superclass

[None]

Attribute	DataType	Multiplicity	Description		
[None]					
Reference	**Class**	**Multiplicity**	**Description**	**Inverse**	**Precedence**
[None]					

Constraints

[None]

5.6.2 Registered_Ontology_Whole_Evolution

Registered_Ontology_Whole_Evolution is a metaclass each instance of which has information on evolution of Registered_Ontology_Wholes.

Superclass

Item_Evolution

Attribute	DataType	Multiplicity	Description		
[None]					
Reference	**Class**	**Multiplicity**	**Description**	**Inverse**	**Precedence**
previous_ version	Registered_ Ontology_ Whole	1..*	The set of instances of Registered_Ontology_Wholes that the evolution represented by this Registered_Ontology_ Whole_Evolution is from	registered_ ontology_ whole_ evolution_ from	Yes
new_version	Registered_ Ontology_ Whole	1..1	The instance of Registered_ Ontology_Whole that the evolution represented by this Registered_Ontology_Whole_ Evolution is to	registered_ ontology_ whole_ evolution_ to	
contained_ registered_ ontology_ component_ evolution	Registered_ Ontology_ Component_ Evolution	0..*	The set of instances of Registered_Ontology_ Component_Evolutions representing the evolution of Registered_Ontology_ Components that form the evolution represented by this Registered_Ontology_Whole_ Evolution	Containing _registered _ontology_ whole_ evolution	Yes

Constraints

[None]

5.6.3 Registered_Ontology_Component_Evolution

Registered_Ontology_Component_Evolution is a metaclass each instance of which has information on evolution of Registered_Ontology_Component.

Superclass

Item_Evolution

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
previous_ version	Registered_ Ontology_ Component	1..*	The set of instances of Registered_Ontology_ Components that the evolution represented by this Registered_Ontology_ Component_Evolution is from	registered_ ontology_ component_ evolution_ from	Yes
new_version	Registered_ Ontology_ Component	1..1	The instance of Registered_ Ontology_Component that the evolution represented by this Registered_Ontology_ Component_Evolution is to	registered_ ontology_ component_ evolution_ to	
contained_ registered_ ontology_ atomic_ construct_ evolution	Registered_ Ontology_ Atomic_ Construct_ Evolution	0..*	The set of instances Registered_Ontology_ Atomic_Construct_Evolutions representing the evolution of Registered_Ontology_ Atomic_Construct that form the evolution represented by this Registered_Ontology_ Component_Evolution	containing_ registered_ ontology_ component_ evolution	Yes
containing_ registered_ ontology_ whole_ evolution	Registered_ Ontology_ Whole_ Evolution	1..*	The set of instances of Registered_Ontology_ Whole_Evolution each of which contain the evolution of Registered_Ontolgy_ Comonent represented by this Registered_Ontolgy_ Component_Evolution	contained_ registered_ ontology_ component_ evolution	No

Constraints

[None]

5.6.4   Registered_Ontology_Atomic_Construct_Evolution

Registered_Ontology_Atomic_Construct_Evolution is a metaclass each instance of which has information on evolution of Registered_Ontology_Atomic_Constructs.

Superclass

Item_Evolution

Attribute	DataType	Multiplicity	Description		
[None]					

Reference	Class	Multiplicity	Description	Inverse	Precedence
previous_ version	Registered_ Ontology_ Atomic_ Construct	1..*	Registered_Ontology_Atomic_ Constructs that the evolution represented by this Registered_ Ontology_Atomic_ Construct_Evolution is from	registered_ ontology_ atomic_ construct_ evolution_ from	Yes
new_ version	Registered_ Ontology_ Atomic_ Construct	1..1	Registered_Ontology_Atomic_ Construct that the evolution represented by this Registered_ Ontology_Atomic_ Construct_Evolution is to	registered_ ontology_ atomic_ construct_ evolution_ to	No
containing_ registered_ ontology_ component_ evolution	Registered_ Ontology_ Component_ Evolution	1..*	The set of instances of Registered_Ontology_ Component_Evolution each of which contain the evolution of Registered_Ontolgy_Atomic_ Construct represented by this Registered_Ontolgy_Atomic_ Construct_Evolution	contained_ registered_ ontology_ atomic_ construct_ evolution	No

Constraints

[None]

Annex A
(informative)

List of Ontology_Languages

This annex suggests that the value of the attribute "name" of "Ontology_Language" be one of the values in column "name" of Table A.1 if there is an appropriate one. If there is not an appropriate one, a new name may be used as the value of the attribute "name" of "Ontology_Language", but it shall be managed in accordance with ISO/IEC 11179-6 (see Reference [13]).

Table A.1 — List of Ontology_Languages

name	Description
CGIF	The dialect of Common Logic specified in Annex B (normative) Conceptual Graph Interchange Format(CGIF), ISO/IEC 24707 Information technology - Common Logic (CL): a framework for a family of logic-based languages (see Reference [5])
CL	A language other than CLIF, CGIF or XCL that conforms to ISO/IEC 24707 Information technology - Common Logic (CL): a framework for a family of logic-based languages (see Reference [5])
CLIF	The dialect of Common Logic specified in Annex A (normative) Common Logic Interchange Format (CLIF), ISO/IEC 24707 Information technology - Common Logic (CL): a framework for a family of logic-based languages (see Reference [5])
KIF	Knowledge Interchange Format specified at http://www-ksl.stanford.edu/knowledge-sharing/kif/
NIAM	Natural language Information Analysis Method specified at http://www.essentialstrategies.com/publications/modeling/niam.htm
ORM	Object Role Modeling specified at http://www.orm.net/
OWL	Any of the sublanguages specified by "OWL Web Ontology Language Semantics and Abstract Syntax", W3C Recommendation (see Reference [6])
OWL2	Any of the sublanguages specified by "OWL 2 Web Ontology Language Conformance", W3C Recommendation (see Reference [7])
RDFS	A language that conforms to "Resource Description Framework (RDF): Concepts and Abstract Syntax" and "RDF Vocabulary Description Language 1.0: RDF Schema", W3C Recommendations (see Reference [8] [9])
SBVR	A language that conforms to "Semantics of Business Vocabulary and Business Rules (SBVR), v1.0", formal/2008-01-02 (see Reference [10])
TM	A language that conforms to ISO/IEC 13250 Information technology – SGML applications – Topic maps (see Reference [11])
UML	ISO/IEC 19501 Information technology - Open Distributed Processing - Unified Modeling Language (UML) Version 1.4.2 (see Reference [12])
XCL	The dialect of Common Logic specified in Annex C (normative) eXtended Common Logic Markup Language (XCL), ISO/IEC 24707 Information technology - Common Logic (CL): a framework for a family of logic-based languages (see Reference [5])

Annex B
(informative)

Example of Basic_Model

B.1 Example of a reference registered ontology

Suppose that some organization establishes a formalized ontology called "RO1" about kernel units in OWL. A kernel unit is a unit with its own name without prefix, such as "metre". In "RO1", there are several sentences about kernel units. Figure B.1 shows three examples of them. Suppose that these sentences are named "RC1", "RC2", and "RC3" as shown in Figure B.1.

RC1

```
<owl:ObjectProperty rdf:ID="dimensionality">
  <rdfs:domain rdf:resource="#Unit" />
  <rdfs:range rdf:resource="#Dimensionality" />
</owl:ObjectProperty>
```

RC2

```
<owl:Class rdf:ID="KernelUnit">
  <rdfs:subClassOf rdf:resource="#Unit"/>
</owl:Class>
```

RC3

```
<KernelUnit rdf:ID="metre">
  <dimensionality>
    <Dimensionality rdf:ID="length"/>
  </dimensionality>
</KernelUnit>
```

where   xmlns:owl=http://www.w3.org/2002/07/owl#
         xmlns:rdf=http://www.w3.org/1999/02/22-rdf-syntax-ns#
         xmlns:rdfs=http://www.w3.org/2000/01/rdf-schema#

Figure B.1 — Three examples of the sentences in RO1

Then, "RC1" means "Dimensionality is a property of a unit.", "RC2" means "A kernel unit is a unit.", and "RC3" means "Metre is a kernel unit whose dimensionality is length.".

Figure B.2 shows how "RO1" is registered as a reference registered ontology in accordance with MFI ontology registration.

< Reference_Registered_Ontology_Whole>

Object01

Attribute/Reference	Literal/Instance
IRI	http://ref1.org/kernel-unit
name	"RO1"
expressing_language	"OWL"
used_reference_registered_ontology_component	Object02
	Object03
	Object04
	...

<Reference_Registered_Ontology_Component>

Object02

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
sentence_identifier	"RC1"
used_reference_registered_ontology_atomic_construct	Object05
	Object06
	Object07
using_reference_registered_ontology_whole	Object01

Object03

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
sentence_identifier	"RC2"
used_reference_registered_ontology_atomic_construct	Object06
	Object08
using_reference_registered_ontology_whole	Object01

Object04

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
sentence_identifier	"RC3"
used_reference_registered_ontology_atomic_construct	Object05
	Object07
	Object08
	Object09
	Object10
using_reference_registered_ontology_whole	Object01

<Reference_Registered_Ontology_Atomic_Construct>

Object05

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"dimensionality"
using_reference_registered_ontology_component	Object02
	Object04

Object06

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"Unit"
using_reference_registered_ontology_component	Object02
	Object03

Object07

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"Dimensionality"
using_reference_registered_ontology_component	Object02
	Object04

Object08

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"KernelUnit"
using_reference_registered_ontology_component	Object03
	Object04

Object09

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"metre"
using_reference_registered_ontology_whole	Object04

Object10

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"length"
using_reference_registered_ontology_whole	Object04

Figure B.2 — Registration of RO1

NOTE 1   For simplicity, the sentences other than "RC1", "RC2", and "RC3" are ignored.

NOTE 2   Objectxx (xx= 01 to 10) are object identifiers introduced only for the descriptive purpose of this example. The detailed specifications of them are beyond the scope of this document.

B.2 Example of another reference registered ontology

Suppose that another organization establishes a formalized ontology called "RO2" about prefixed units in OWL. A prefixed unit is a unit with prefix, such as "kilometre". In "RO2", there are several sentences about prefixed units. Figure B.3 shows two examples of them. Suppose that these sentences are named "RC4" and "RC5" as shown in Figure B.3.

RC4

```
<owl:Class rdf:ID="PrefixedUnit">
  <rdfs:subClassOf rdf:resource="&ref1;Unit"/>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:about="#prefix"/>
      <owl:cardinality rdf:datatype="&xsd;int">1</owl:cardinality>
    </owl:Restriction>
  </rdfs:subClassOf>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:about="#kernel"/>
      <owl:cardinality rdf:datatype="&xsd;int">1</owl:cardinality>
    </owl:Restriction>
  </rdfs:subClassOf>
</owl:Class>
```

RC5

```
<PrefixedUnit rdf:ID="micrometre">
  <prefix>
    <MetricPrefix rdf:ID="micro"/>
  </prefix>
  <kernel>
    <ref1:KernelUnit rdf:resource="&ref1;metre"/>
  </kernel>
</PrefixedUnit>
```

Figure B.3 — Two examples of the sentences in RO2

Then, "RC4" means "A prefixed unit is a unit, has exactly one prefix, and has exactly one kernel." and "RC5" means "Micrometre is a prefixed unit whose prefix is micro as a metric prefix and whose kernel is metre as a kernel unit.".

Figure B.4 shows how "RO2" is registered as a reference registered ontology in accordance with MFI ontology registration.

< Reference_Registered_Ontology_Whole>

Object11

Attribute/Reference	Literal/Instance
IRI	http://ref2.org/prefixed-unit
name	"RO2"
expressing_language	"OWL"
used_reference_registered_ ontology_component	Object12
	Object13
	...

<Reference_Registered_Ontology_Component>

Object12

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
sentence_identifier	"RC4"
used_reference_registered_ ontology_atomic_construct	Object06
	Object14
	Object15
	Object16
using_reference_registered_ ontology_whole	Object11

Object13

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
sentence_identifier	"RC5"
used_reference_registered_ ontology_atomic_construct	Object08
	Object09
	Object14
	Object15
	Object16
	Object17
	Object18
	Object19
using_reference_registered_ ontology_whole	Object11

<Reference_Registered_Ontology_Atomic_Construct>

Object06

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"Unit"
using_reference_registered_ ontology_component	Object02
	Object03
	Object12

Object07

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"Dimensionality"
using_reference_registered_ ontology_component	Object02
	Object04
	Object13

Object08

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"KernelUnit"
using_reference_registered_ ontology_component	Object03
	Object04
	Object13

Object09

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"metre"
using_reference_registered_ ontology_component	Object04
	Object13

Object14

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"PrefixedUnit"
using_reference_registered_ ontology_component	Object12
	Object13

Object15

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"prefix"
using_reference_registered_ ontology_component	Object12
	Object13

Object16

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"kernel"
using_reference_registered_ ontology_component	Object12
	Object13

Object17

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"micrometre"
using_reference_registered_ ontology_component	Object13

Object18

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"MetricPrefix"
using_reference_registered_ ontology_component	Object13

Object19

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"micro"
using_reference_registered_ ontology_component	Object13

Figure B.4 — Registration of RO2

NOTE 1   For simplicity, the sentences other than "RC4" and "RC5" are ignored.

NOTE 2   Objectxx (xx= 02 to 19) are object identifiers introduced only for the descriptive purpose of this example. The detailed specifications of them are beyond the scope of this document.

B.3   Example of a local registered ontology

Suppose that some application system establishes its own ontology called "LO1" about units based on "RO1" (described in B.1) and "RO2" (described in B.2). "LO1" is expressed in KIF and not in OWL and its authoritative level is "local1". In "LO1", there are several sentences about units for this application system. Figure B.5 shows three examples of them. Suppose that these sentences are named "LC1", "LC2", and "LC3" as shown in Figure B.5.

LC1

> (and (KernelUnit metre) (Dimensionalitylength) (dimensionalitymetre length))

LC2

> (and (PrefixedlUnit micron) (MetricPrefix micro) (KernelUnit metre)
>
> (prefix micron micro) (kernel micron metre))

LC3

> ((forall ?Unit1 ?Unit2 ?Dimensionality1 ?Dimensionality2)
>
> (implies (and (PrefixedUnit ?Unit1) (kernel ?Unit1 ?Unit2)
>
> (dimensionality ?Unit1 ?Dimensionality1) (dimensionality ?Unit2 ?Dimensionality2))
>
> (equal ?Dimensionality1 ?Dimensionality2)))

Figure B.5 — Three examples of the sentences in LO1

Then, "LC1" has the same meaning as "RC3" in "RO1" and uses the same non-logical symbols as "RC3" in "RO1".

"LC2" has the same meaning as "RC5" in "RO2" and uses the same non-logical symbols as "RC5" in "RO2", except that "micron" is used instead of "micrometre" for this application system.

"LC3" is a new sentence that is not in "RO1" or in "RO2". "LC3" means "Dimensionality of a kernel unit and the dimensionality of the prefixed unit whose kernel is the kernel unit are equal.".

Figure B.6 shows how "LO1" is registered as a local registered ontology in accordance with MFI ontology registration.

<Local_Registered_Ontology_Whole>

Object20

Attribute/Reference	Literal/Instance
authoritative_level	Object25
IRI	http://local1.org/unit
name	"LO1"
expressing_language	"KIF"
used_local_registered_ ontology_component	Object21
	Object22
	Object23
	...

<Local_Registered_Ontology_Component>

Object21

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
sentence_identifier	"LC1"
used_reference_registered_ ontology_atomic_construct	Object05
	Object07
	Object08
	Object09
	Object10
using_local_registered_ ontology_whole	Object20
same_as	Object04

Object22

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
sentence_identifier	"LC2"
used_reference_registered_ ontology_atomic_construct	Object08
	Object09
	Object14
	Object15
	Object16
	Object18
	Object19
used_local_registered_ ontology_atomic_construct	Object24
using_local_registered_ ontology_whole	Object20
same_as	Object13

Object23

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
sentence_identifier	"LC3"
used_reference_registered_ ontology_atomic_construct	Object05
	Object14
	Object16
using_local_registered_ ontology_whole	Object20

<Reference_Registered_Ontology_Atomic_Construct>

Object05

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"dimensionality"
using_reference_registered_ ontology_component	Object02
	Object04
using_local_registered_ ontology_component	Object21
	Object23

Object07

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"Dimensionality"
using_reference_registered_ ontology_component	Object02
	Object04
	Object13
using_local_registered_ ontology_component	Object21

Object08

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"KernelUnit"
using_reference_registered_ ontology_component	Object03
	Object04
	Object13
using_local_registered_ ontology_component	Object21
	Object22

Object09

Attribute/Reference	Literal/Instance
namespace	http://ref1.org/kernel-unit
non_logical_symbol	"metre"
using_reference_registered_ ontology_component	Object04
	Object13
using_local_registered_ ontology_component	Object21
	Object22

Object14

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"PrefixedUnit"
using_reference_registered_ ontology_component	Object12 Object13
using_local_registered_ ontology_component	Object22 Object23

Object15

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"prefix"
using_reference_registered_ ontology_component	Object12 Object13
using_local_registered_ ontology_component	Object22

Object16

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"kernel"
using_reference_registered_ ontology_component	Object12 Object13
using_local_registered_ ontology_component	Object22 Object23

Object17

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"micrometre"
using_reference_registered_ ontology_component	Object113
same_as	Object24

Object18

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"MetricPrefix"
using_reference_registered_ ontology_component	Object113
using_local_registered_ ontology_component	Object22

Object19

Attribute/Reference	Literal/Instance
namespace	http://ref2.org/prefixed-unit
non_logical_symbol	"micro"
using_reference_registered_ ontology_component	Object113
using_local_registered_ ontology_component	Object22

<Local_Registered_Ontology_Atomic_Construct>

Object24

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
non_logical_symbol	"micron"
using_local_registered_ ontology_component	Object22
same_as	Object17

<Authoritative_Extent>

Object25

Attribute/Reference	Literal/Instance
authoritative_extent	"local1"
less_than_or_equal_to	...
greater_than_or_equal_to	...
authoritative_extent_local_ item	Object20 Object21 Object22 Object23 Object24 ...

Figure B.6 — Registration of LO1

NOTE 1   For simplicity, the sentences other than "LC1", "LC2", and "LC3" are ignored.

NOTE 2   Objectxx (xx= 02 to 25) are object identifiers introduced only for the descriptive purpose of this example. The detailed specifications of them are beyond the scope of this document.

B.4   Example of another local registered ontology

Suppose that another application system establishes its own ontology called "LO2" about units based on "LO1" (described in B.3), "RO1" (described in B.1) and "RO2" (described in B.2). "LO2" is also expressed in KIF and its authoritative level is "local2", which is less than or equal to "local1", which is the authoritative level of "LO1". "LO2" reuses "LC1" and "LC2", sentences in "LO1" and have several other sentences about units for this application system. Figure B.7 shows an example of them. Suppose that this sentence is named "LC4" as shown in Figure B.7.

LC4

(and (PrefixedlUnit angstrom) (MetricPrefix 100pico) (KernelUnit metre)
(prefix angstrom100pico) (kernelangstrom metre))

Figure B.7 — An example of the sentences in LO2

Then, "LC4" is a new sentence that is not in either "RO1", "RO2" or "LO1". "LC4" means "Angstrom is a prefixed unit whose prefix is 100pico as a metric prefix and whose kernel is metre as a kernel unit."

Figure B.8 shows how "LO1" is registered as a local registered ontology in accordance with MFI ontology registration.

<Local_Registered_Ontology_Whole>

Object26

Attribute/Reference	Literal/Instance
authoritative_level	Object30
IRI	http://local2.org/unit
name	"LO2"
expressing_language	"KIF"
used_local_registered_ ontology_component	Object21
	Object22
	Object27
	...

<Local_Registered_Ontology_Component>

Object21

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
sentence_identifier	"LC1"
used_reference_registered_ ontology_atomic_construct	Object05
	Object07
	Object08
	Object09
	Object10
using_local_registered_ ontology_whole	Object20
	Object26
same_as	Object04

Object22

Attribute/Reference	Literal/Instance
authoritative_level	Object25
namespace	http://local1.org/unit
sentence_identifier	"LC2"
used_reference_registered_ ontology_atomic_construct	Object08
	Object09
	Object14
	Object15
	Object16
	Object18
	Object19
used_local_registered_ ontology_atomic_construct	Object24
using_local_registered_ ontology_whole	Object20
	Object26
same_as	Object13

Object27

Attribute/Reference	Literal/Instance
authoritative_level	Object30
namespace	http://local2.org/unit
sentence_identifier	"LC4"
used_reference_registered_ ontology_atomic_construct	Object08
	Object09
	Object14
	Object15
	Object16
used_local_registered_ ontology_atomic_construct	Object28
	Object29
using_local_registered_ ontology_whole	Object26