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Open Geospatial Consortium

OGC GUIDANCE FOR THE DEVELOPMENT OF MODEL-DRIVEN STANDARDS

DISCUSSION PAPER
General

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I ABSTRACT

This OGC Discussion Paper provides guidelines on how to create a specification of a conceptual model through use of a Unified Modeling Language (UML) editor and an AsciiDoc compiler. This document references Sparx Systems Enterprise Architect and the Metanorma AsciiDoc toolchain in examples that implement the OGC model-driven standards process, described in OGC 21-035r1.

II KEYWORDS

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, MDA, model-driven

III PREFACE

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IV SECURITY CONSIDERATIONS

No security considerations have been made for this document.

V SUBMITTERS

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1 SCOPE

1 SCOPE

This Discussion Paper focuses on the development of Model-Driven Standards (MDS) using Sparx Systems Enterprise Architect and the Metanorma AsciiDoc toolchain. However, the guidelines could also be adapted for use with other UML and Asciidoc tools.

Development of this document was led by the MUDDI Standards Working Group, with the support of an Ordnance Survey-funded project in which this document served as Deliverable D1. The Scope of the guidelines, however, is not limited to underground data as many of the guidelines have been previously applied to other OGC Standards (e.g., CityGML).

2

CONFORMANCE

2 CONFORMANCE

Conformance with this document shall be checked using all of the tests specified in Annex A of this document.

3

NORMATIVE REFERENCES

3 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.

Policy SWG: OGC 08-131r3, *The Specification Model — Standard for Modular specifications*. Open Geospatial Consortium (2009).

Ronald Tse, Nick Nicholas: OGC 21-035r1, *OGC Testbed-17: Model-Driven Standards Engineering Report*. Open Geospatial Consortium (2022). http://www.opengis.net/doc/PER/t17-D022.

OMG UML 2.5, *Unified Modeling Language*. (2015). https://www.omg.org/spec/UML/2.5/About-UML.

OMG XMI 2.5.1, *XML Metadata Interchange*. (2015). https://www.omg.org/spec/XMI/2.5.1/About-XMI.

OMG OCL 2.4, *Object Constraint Language*. (2014). https://www.omg.org/spec/OCL/2.4/About-OCL.

4

TERMS AND DEFINITIONS

4 TERMS AND DEFINITIONS

This document uses the terms defined in OGC Policy Directive 49, which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this document and OGC documents do not use the equivalent phrases in the ISO/IEC Directives, Part 2.

This document also uses terms defined in the OGC Standard for Modular specifications (OGC 08-131r3), also known as the ‘ModSpec’. The definitions of terms such as standard, specification, requirement, and conformance test are provided in the ModSpec.

For the purposes of this document, the following additional terms and definitions apply.

4.1. conceptual model

CM ALTERNATIVE

model that defines concepts of a universe of discourse

[**SOURCE:** ISO 19101-1, Clause 4.1.5]

4.2. conceptual schema

formal description of a *conceptual model* (Clause 4.1)

[**SOURCE:** ISO 19101-1, Clause 4.1.6]

4.3. model-driven standard

MDS ALTERNATIVE

standard created using a model-driven architecture

[**SOURCE:** OGC 21-035r1, Clause 2.1.4]

4.4. model-driven architecture
MDA ALTERNATIVE

software design approach for development of software systems centered around data models

[**SOURCE:** OMG UML 2.5]

4.5. model authoring tool

software used for authoring a *conceptual model* (Clause 4.1)

[**SOURCE:** OGC 21-035r1]

4.6. platform-independent model
PIM ALTERNATIVE

data model that does not contain platform-specific concerns

[**SOURCE:** OGC 21-035r1]

4.7. platform-specific model
PSM ALTERNATIVE

data model that contains platform-specific concerns

[**SOURCE:** OGC 21-035r1]

4.8. logical model

implementation of one or more *conceptual models* (Clause 4.1) intended for a logical domain

4.9. model transformation

model conversion from one form to another which may not preserve all semantics

[**SOURCE:** OGC 21-035r1]

4.10. model conversion

process that converts a data model in one format into another format that preserves all model semantics

[**SOURCE:** OGC 21-035r1]

4.11. stereotype

extension of an existing UML metaclass that enables the use of platform or domain specific terminology or notation in place of, or in addition to, those used for the extended metaclass

[**SOURCE:** OMG UML 2.5]

4.12. tagged value

attribute on a stereotype used to extend a UML model element

[**SOURCE:** OMG UML 2.5]

4.13. UML profile

predefined set of stereotypes, tagged values, constraints, and notation icons that collectively specialize and tailor UML for a specific domain or process

[**SOURCE:** ISO/IEC 19501]

5

INTRODUCTION

5 INTRODUCTION

The MDS process described in OGC 21-035r1 enables standardized documentation of conceptual models in UML, which could be platform-independent models (PIMs) or platform-specific models (PSMs).

In the past, UML modeling activity and the OGC authoring process used disparate tools, causing OGC authors and editors much difficulty in the synchronization of changes originating from either activity, as illustrated in Figure 1.

OGC 21-041r2 also discusses a number of challenges involved in UML modeling.

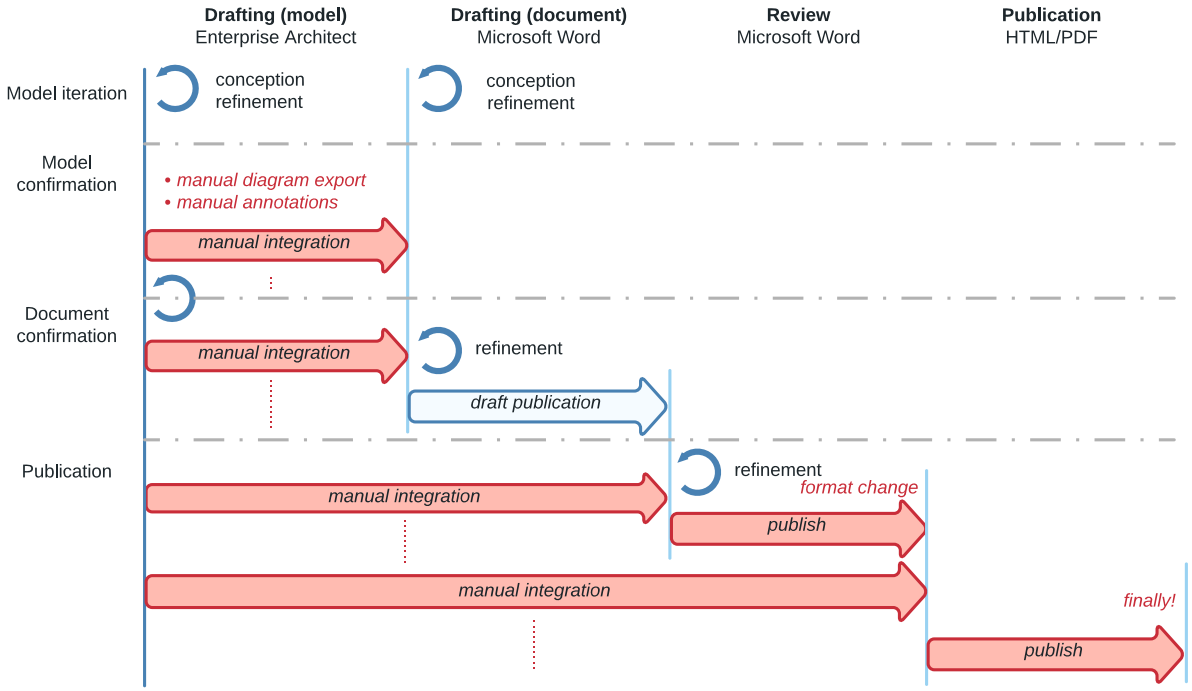


Figure 1 — Manual process for iterating a model-driven standard

As studied in OGC Testbed-17, OGC 21-035r1 has investigated several options in model-driven authoring, in which the OGC MUDDI SWG has decided to adopt and sponsor development of a particular approach that utilizes the following combination of tools:

- Enterprise Architect (from Sparx Systems) in the creation and maintenance of UML models, and
- Metanorma (from Ribose) in the authoring of OGC deliverables.

This combination of tools can provide a streamlined development environment for OGC working groups developing conceptual model standards.

- By maintaining standards content in the model, simplifying and decoupling the model maintenance process is possible.
- Storing annotations and guidance about the model together with the actual model enables a single source of truth that can streamline the standards authoring process.

This document is meant to describe best practices that enable achievement of these benefits.

By utilizing described practices of this document, the streamlined automated MDS process can be achieved as shown in Figure 2.

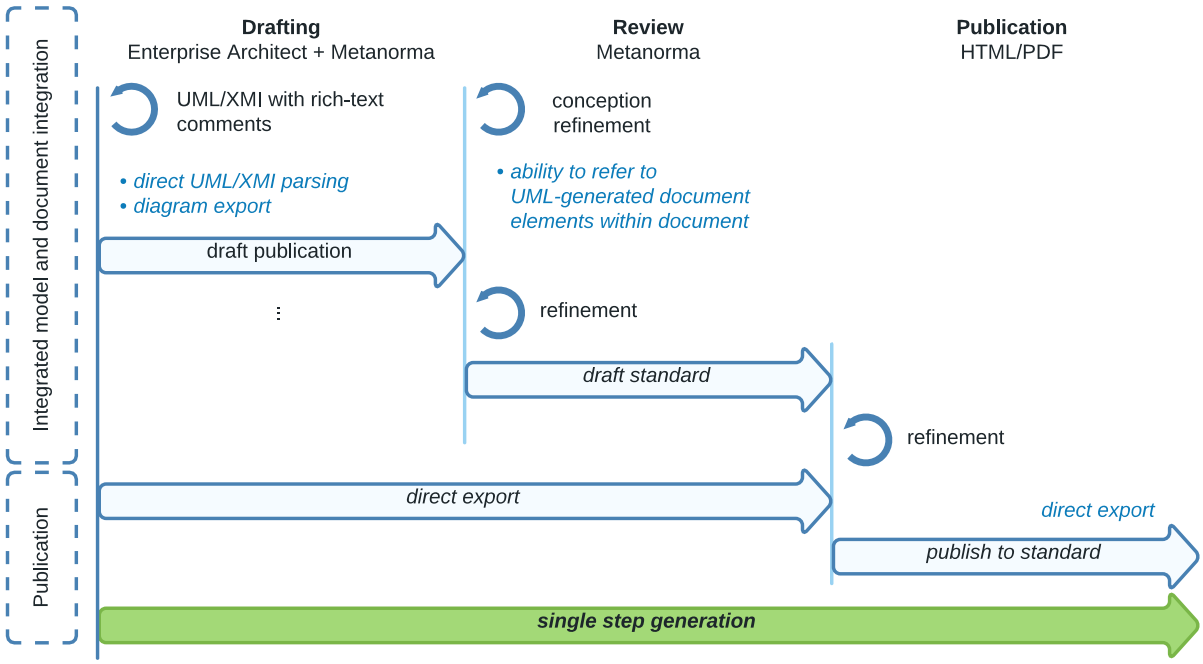


Figure 2 — One-step automated process for iterating a model-driven standard

6

DEVELOPING AN MDS

6 DEVELOPING AN MDS

6.1. General

The creation of an MDS must be planned. An MDS involves the synthesis of multiple data sources into a single one, therefore the MDS creator must be aware of the integration points and limitations of such synthesis process.

While the MDS process is meant to be a streamlined, automated process, it is nonetheless dependent on the interaction of multiple state-of-the-art technologies and **requires** the MDS creator to have a thorough understanding of the MDS technologies and techniques involved.

The full process is shown in Figure 3.

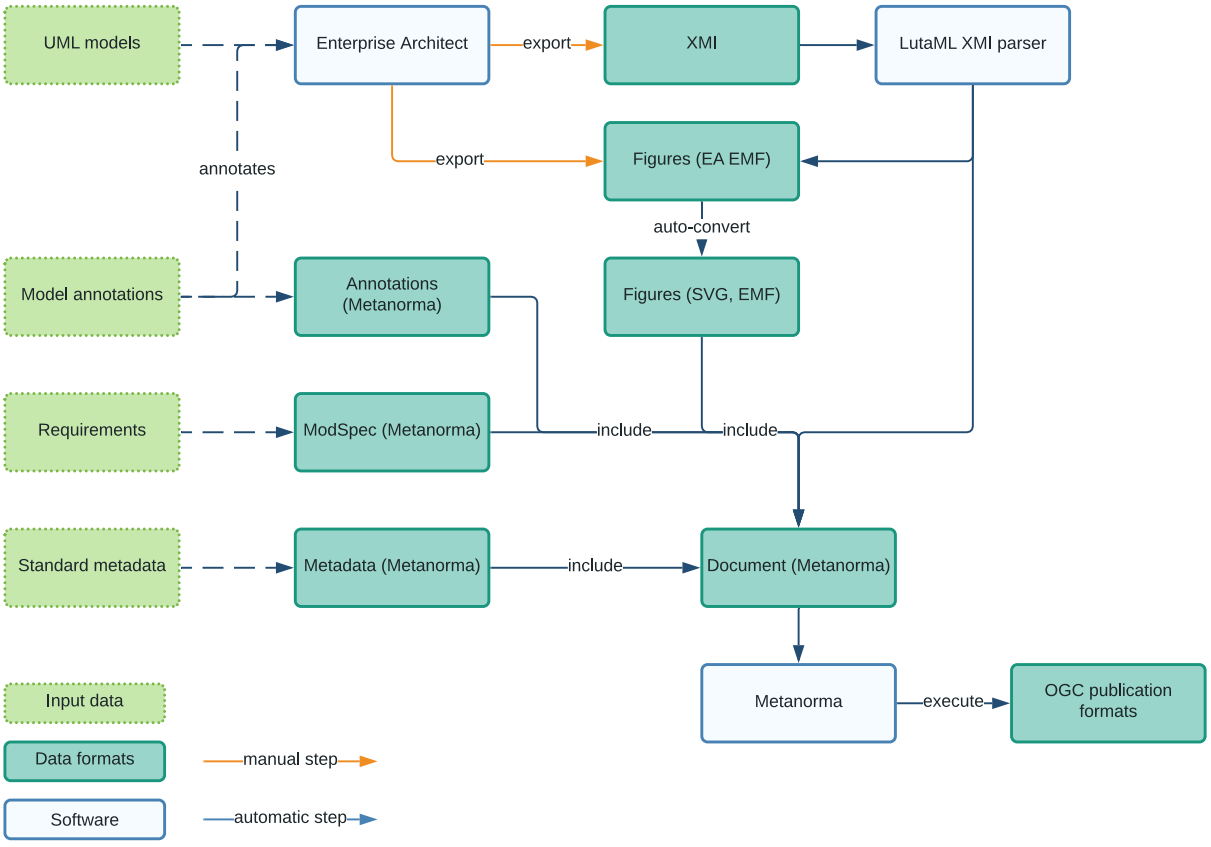


Figure 3 — Model-driven standard detailed publication flow

6.2. Data sources

Before embarking on an MBS, it is necessary for the MDS creator to know what kind of components there are.

In OGC, a model-driven standard is typically created with the following components:

- OGC document information in Metanorma AsciiDoc (scope, bibliography, etc.);
- UML model information in OMG XMI format (the EA UML models with annotations); and
- OGC ModSpec information in Metanorma AsciiDoc format (requirements, conformance tests).

These components read into Metanorma using a defined processing configuration, and are then combined in Metanorma to form the MDS.

The resulting MDS represented in the Metanorma format will be expressed in the models provided in Figure 4.

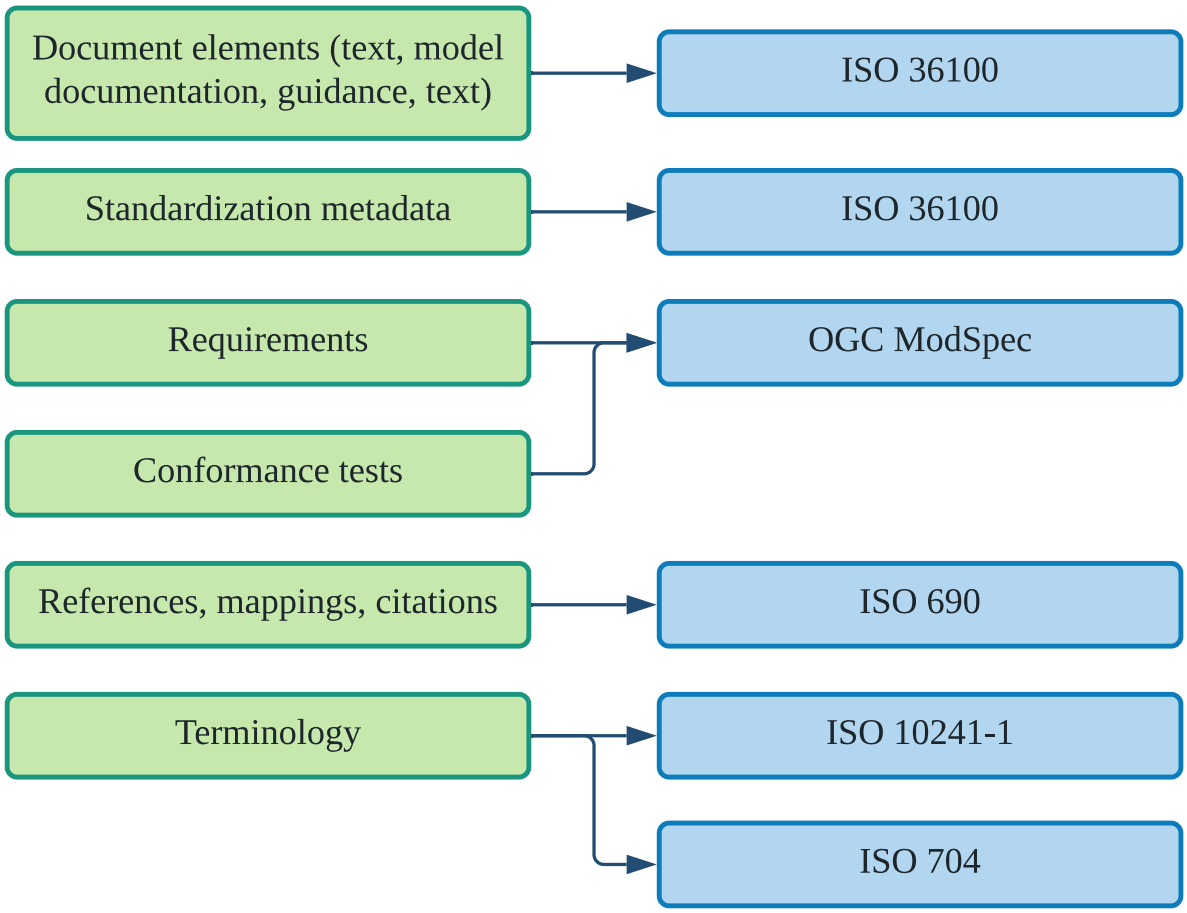


Figure 4 — Model-driven standard information components

REQUIREMENTS CLASS 1: IDENTIFICATION OF SOURCE COMPONENTS OF THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/core`
TARGET TYPE	Model-driven standard
CONFORMANCE CLASS	Conformance class A.1: `/conf/core`
DESCRIPTION	The source components of the model-driven standard has to be identified and understood.
NORMATIVE STATEMENT	Requirement 1: `/req/core/document`

REQUIREMENT 1: READINESS OF OGC DOCUMENT INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/core/document`
INCLUDED IN	Requirements class 1: `/req/core`
STATEMENT	The OGC document information used in the model-driven standard is completed and made available to the model-driven standard in the Metanorma AsciiDoc format.

REQUIREMENT 2: READINESS OF UML MODEL INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/core/uml`
STATEMENT	The UML model used in the model-driven standard is completed and made available to the model-driven standard in the OMG XMI format.

REQUIREMENT 3: READINESS OF OGC DOCUMENT METADATA INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/core/metadata`
STATEMENT	The OGC document metadata used in the model-driven standard is completed and made available to the model-driven standard in the Metanorma AsciiDoc format.

6.3. Principles

OGC 21-035r1 states that generation of an MDS involves the following steps:

- Export: Making the information model available for processing;
- Authoring: Making the supplementary truth available for processing;
- Data parsing: Parsing the truth of the model into derived truth in the document;
- Integrating: Merging derived and supplementary truth into the target document; and
- Rendering: Generating human-consumable presentations of the target document.

This document provides practices that allow the MDS author to plan out how the MDS automation process looks like across all these stages.

6.4. Export

Making source data available for the MDS involves exporting the information models in a standardized interoperable format from the model authoring tool.

For an OGC MDS document:

- the primary truth is typically a set of UML models; the initial step in processing is to export these UML models into interoperable XMI files; and
- the secondary set of source data are the UML diagrams accompanying the UML models; these diagrams provide visual representations of UML classes described in the XMI files.

6.5. Authoring

This information is written in Metanorma, using the OGC flavor of the Metanorma AsciiDoc markup language.

Supplementary information in an MDS normally includes the following.

- Material such as bibliographies, terminological definitions, tutorial guidance, annexes, and prefatory material, which form part of a document presenting and explaining the model.
- Metadata about the document, such as keywords and identifiers.
- Requirements conforming to OGC ModSpec.

Where the supplementary information references specific model artifacts (annotating them), cross-references from Metanorma to the model become necessary; those cross-references are part of the integration of derived and supplementary truth.

6.6. Data parsing

Processing the XMI file is done under the Metanorma approach to MDA by LutaML. LutaML returns to Metanorma an array of objects, one for each of the objects in the source file parsed by LutaML, with a plugin structure to deal with the range of formats LutaML is called on to process (`lutaml-xmi`, in this instance).

Metanorma then uses Liquid directives to iterate through those objects, and insert information from them into Metanorma AsciiDoc templates. These templates are how information from the model is incorporated into the MDS as derived truth.

By using LutaML commands inside Metanorma, such as the `lutaml_uml_datamodel_description` command, UML class information is parsed from a nominated XMI file and transformed into Metanorma AsciiDoc.

Configuration files were used to specify which packages to render for each command call, in which sequence, and how to display them.

For complex documents such as CityGML 3.0 that require a non-default way of rendering, additional configuration can be used to achieve such results.

6.7. Integrating

A wide range of information is integrated into the target document.

This information is typically organized into separate directories in the source repository.

- The main Metanorma AsciiDoc document (`nn-mmm.adoc`), containing document metadata and directives to include sections contained in the document.
- The Metanorma AsciiDoc documents for each section in the standard (`sections/*.adoc`).
- Generic ModSpec requirements (not specific to the information models), each expressed as a separate file of Metanorma AsciiDoc, are included into the section documents at the appropriate point (`abstract_test`, `recommendations`, `requirements`).
- Non-model-generated images (`images`) and figures (`figures`) are included in the document as supplementary truths, as distinct from the UML diagrams exported into `/xmi-full/Images` as derived truths.

Supplementary truth is incorporated into the target document through standard AsciiDoc commands:

- `image::` for images and figures
- `include::` for content.

6.8. Rendering

Once the Metanorma AsciiDoc source is assembled out of its component truths, it can then be rendered using Metanorma into a number of output formats.

- Metanorma Semantic XML, capturing the structure and meaning of the standards document, and following the document model in ISO/AWI 36100.

- Metanorma Presentation XML, denormalizing the structure of the standards document in preparation for rendering, including resolving cross-references and generating auto-numbering.
- HTML
- PDF
- Microsoft Word

7

TECHNOLOGY AND TOOLS

7 TECHNOLOGY AND TOOLS

7.1. General

Practices described in this document are meant for OGC working group participants fluent in the development of:

- Conceptual models described using UML Class Diagrams; and
- OGC authoring practices.

This document does not delve into details of those areas — readers may wish to consult other literature for the full understanding of the practices described.

7.2. Conceptual models described using UML Class Diagrams

7.2.1. General

ISO/IEC 19501 specifies the UML modelling language, a graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system.

UML specifies a set of methodologies for developing technical artifacts used in the design of a software system, ranging from business processes and system functions to programming language statements, database schemas, and reusable software components. UML is often used to develop domain-specific models (e.g., geospatial information) used in system development.

The usage of UML in MDS lies with two aspects:

- For model definition, the definition of information models and their relationships, that contain human- and machine-readable components; and
- For class diagrams, the visual arrangement of UML class relationships intended for human consumption only.

7.2.2. Modeling elements

A detailed description of UML modelling capabilities can be found in OGC 21-035r1, Clause 5.1.

UML provides 3 basic modeling elements.

Package	A package is a defined collection of interrelated classes.
Class	A class is an abstract representation of a real-world object, which contains properties.
Property	A property represents an aspect of a class.

UML allows additional modeling extensions in the following 3 ways:

Stereotype	A defined set of properties that a Class can adopt as a whole, commonly representing a platform-specific or domain-specific concern. More than one stereotype can be adopted by a single Class.
Tagged Value	A structured key-value pair defined for a UML element, allowing the attachment of additional (custom) information to the UML element.
Constraint	A string that limits possible value assignments to the property.

The UML “Profile” is another mechanism that allows for the easy application of stereotypes.

Profile	A profile contains multiple UML stereotypes that a UML model can adopt.

7.3. UML profiles for geospatial models

7.3.1. General

A number of common UML profiles are used for geospatial UML modeling.

7.3.2. UML Standard Profile

The UML Standard Profile is provided by the UML standard (OMG UML 2.5).

It provides the following stereotypes for Classes.

«Auxiliary»	A class that supports another class.
«Focus»	A class that specifies core logic or control with auxiliary classes that provide subordinate mechanisms.

«ImplementationClass»	An implementation class of a class.
«Metaclass»	A UML element that is meant to be extended.
«Realization»	A realization of an abstract UML element.
«Specification»	A specialization of a UML element.
«Type»	A data type.
«Utility»	A class that supports functionality of more than one class.

7.3.3. GML

In the geospatial domain, stereotypes from the Geography Markup Language (GML) standard (OGC 07-036r1) are often applied to geospatial UML elements.

The GML standard provides the following Stereotypes that apply to Classes.

«CodeList»	A list of enumerated codes. Practically an enumeration.
«DataType»	A basic type of information.
«FeatureType»	A type of feature.
«Type»	A type of information.
«Union»	A union of two classes.

The GML standard provides the following Stereotypes that apply to Properties:

«property»	A basic property.

7.3.4. ISO 19100-series profile: Conceptual schema language (ISO 19103:2015)

ISO 19103:2015 provides rules and guidelines for the use of a conceptual schema language to model geographic information, and specifies a profile of UML.

It includes 6 stereotypes.

«Interface»	(formerly «`Type`») is an abstract classifier with operations, attributes and associations, which can only inherit from or be inherited by other interfaces (or types).
«DataType»	is a set of properties that lack identity (independent existence and the possibility of side effects). A data type is a classifier with no operations, whose primary purpose is to hold information.

«Union»	is a type consisting of one and only one of several alternative datatypes (listed as member attributes); this is similar to a discriminated union in many programming languages.
«Enumeration»	is a fixed list of valid identifiers of named literal values. Attributes whose range type is an enumeration may only take values from the fixed list.
«CodeList»	is a flexible enumeration that uses string values for expressing a list of potential values. The allowed values are often held and managed using an online register.
«Leaf»	is a package that contains only classes (packages are disallowed).

The ISO 19103:2015 profile of UML also includes one tagged value:

- `codeList`, applies to stereotype «`CodeList`»: Code lists managed by a single external authority may carry a tagged value "codeList" whose value references the actual external code list. If the tagged value is set, only values from the referenced code list are valid.

The ISO 19103:2015 profile of UML is summarized in Figure 5.

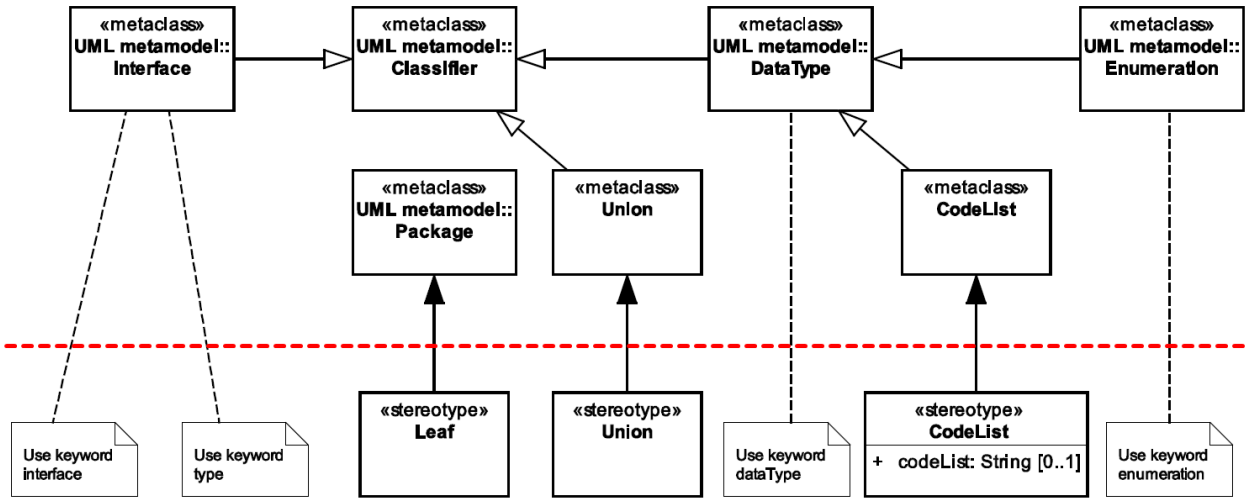


Figure 5 — ISO 19103:2015 stereotypes and keywords

7.3.5. ISO 19100-series profile: Rules for application schema (ISO 19109:2015)

ISO 19109:2015 defines rules for creating and documenting application schemas (conceptual schemas for data required by one or more applications), including principles for the definition of features, a fundamental unit of geographic information. As part of the general rules for application schemas it specifies the "General Feature Model" (GFM), the meta-model for application schemas.

The ISO 19109:2015 profile of UML that is used as the conceptual schema language for application schemas adds 2 stereotypes and 3 tagged values.

«ApplicationSchema»	(package) stereotype
«FeatureType»	(class) stereotype

The following 3 tagged values apply to both of these stereotypes.

designation	Natural language designator for the element to complement the name. Optional, with multiple designations allowed in order to support different languages.
definition	Concise definition of the element. One definition is mandatory. Additional definitions can be provided in multiple languages if required.
description	Description of the element, including information beyond that required for concise definition but which may assist in understanding its scope and application. Optional, with multiple descriptions allowed in order to support different languages.

The ISO 19109:2015 profile of UML is summarized in Figure 6:

Stereotype or keyword	UML metaclass	Constraints	Tagged values	Source
ApplicationSchema	Package		version	This International Standard, 8.2.3
			description catalogue-entry	This International Standard, 8.2.4
		Not nested in another applicationSchema package		This International Standard, 8.2.5
			language designation definition	This International Standard, 8.12
CodeList	Class			ISO 19103:—[5], 6.5.3, 6.10
dataType		Use in attributes or strong aggregation (composition)		ISO/IEC 19505-2:2012, 7.3.11 ISO 19103:—[6], 6.10
enumeration				ISO/IEC 19505-2:2012, 7.3.16 ISO 19103:—[7], 6.5.2, 6.10
Estimated	Property			This International Standard, 8.2.9
FeatureType	Class		description	This International Standard, 8.2.4, 8.2.6
			designation definition	This International Standard, 8.12
Leaf	Package	Cannot contain another package		ISO 19103:—[8], 6.10
Union	DataType			ISO 19103:—[9], 6.10
use				ISO/IEC 19505-2:2012, 7.3.40

Figure 6 — Summary of ISO 19109:2015 profile of UML

7.3.6. ISO 19118:2011 Geographic information — Encoding

ISO 19118:2011 specifies the requirements for defining encoding rules for use in the interchange of data that conform to the geographic information in the set of International Standards known as the "ISO 19100 series." It specifies requirements for creating encoding rules based on UML schemas, requirements for creating encoding services, and requirements for XML-based encoding rules for neutral interchange of data. It specifies a profile of UML that includes eight stereotypes, two of which are not previously defined similarly by either ISO 19103:2015 or ISO 19109:2015.

The profile provides the following stereotypes for Classes.

«BasicType»	"Defines a basic data type that has defined a canonical encoding. " (ISO 19118:2011, Clause C.2.1.2) Additionally stated is that: "This canonical encoding may define how to represent values of the type as bits in a memory location or as characters in a textual encoding. Examples of simple types are integer, float and string." **NOTE 1:** For translation into XML, ISO 19118:2011, Clause C.5.2.1.1 states: "A class stereotyped «`BasicType`» shall be converted to a simpleType declaration in XML Schema. Any of the data types defined in XML Schema can be used as building blocks to define user-defined basic types. The encoding of the basic types shall follow the canonical representation defined in XML Schema Part 2: Datatypes (W3C xmlschema-2)." **NOTE 2:** The different types are not clearly defined in ISO/TS 19103:2005 and neither is the «`BasicType`» stereotype used. The following declarations, therefore, follow a subset of the data type definitions in W3C xmlschema-2. Declared are the types: Number, Integer, Decimal, Real, Vector, Character, CharacterString, Date, Time, DateTime, Boolean, Logical, Probability, Binary, and UnlimitedInteger (where the symbol "*" is used to represent the infinite value).
«Interface»	"Defines a service interface and shall not be encoded." (ISO 19118:2011, Clause C.2.1.2) This definition is inconsistent with that of the subsequently published ISO 19103:2015. While this inconsistency may be useful in contexts where it is clear which definition applies, in general it is undesirable to overload the meanings of stereotypes within the OGC community, and in particular thereby coming into conflict with a stereotype specified in ISO 19103:2015. While the stereotype «`Interface`» as defined in ISO 19118:2011 can be (and is here) subsequently ignored, the stereotype «`BasicType`» is used in the CityGML 3.0 Conceptual Model where it results in difficulties given its tie to a specific encoding technology — XML Schema — and thus lack of true platform independence. The CityGML 3.0 Conceptual Model

redefines the stereotype «`BasicType`» to mean “defines a basic data type”, which is both circular and differs from that of ISO 19118:2011.

7.4. Sparx Systems Enterprise Architect

Sparx Systems Enterprise Architect (EA) is widely used in OGC and ISO/TC 211 for the authoring and management of UML models.

EA Version 16 is a Windows application, it can be run in 32-bit or 64-bit mode on Windows, and can be run on other platforms using CrossOver (which is based on WINE technology) with 32-bit emulation.

7.5. Metanorma for OGC

Metanorma is an open-source framework for creating and publishing standardization artifacts with the focus on semantic authoring and flexible output support.

“Metanorma for OGC” is an OGC-specific implementation that has been approved as an official way to publish new OGC Standard documents since 2021-09-17. Metanorma-based document templates have been approved by the OGC Document SubCommittee on 2022-02-25.

Metanorma for OGC documents are created in the Metanorma AsciiDoc format. Metanorma AsciiDoc is a textual syntax for preparing a ISO/AWI 36100 compliant document model tree which can be rendered in a variety of presentation formats.

At its core, Metanorma provides a model-based documentation system and prioritizes automation, through the following features:

- a set of standard document metamodels (according to ISO/AWI 36100) that allows different standardization bodies to create their own standardized deliverable model, which in turn relies on the following standardized models:
    - ISO/PWI 36200 standards metadata specification metamodels;
    - ISO 690 bibliographic and citation item models;
    - ISO 10241-1 and ISO 704 concept organization and terminology models;
- a standard XML serialization (ISO/PWI 36300) for machine-readable standardization documents; and
- an open-source publishing toolchain that enables editors of standard documents to handle their documents from authoring to publishing in an end-to-end, “author-to-publish” fashion.

For OGC usage, it provides the following additional features:

- Rendering outputs in PDF, HTML, Microsoft Word, and ISO/AWI 36100 XML formats;
- Support for specification of OGC Standards metadata, including document types, stages, identifiers and authorship;
- Support for specification of OGC ModSpec (OGC 08-131r3) model instances through a specialized syntax; and
- For OGC MDS usage, Metanorma supports navigation for information models in the OMG UML/XMI format (OMG UML within OMG XMI in XML format, OMG UML 2.5, OMG XMI 2.5.1) generated from Enterprise Architect, through the LutaML information model parser.

Figure 7 shows the range of models used in Metanorma, including the OGC-specific use of OGC ModSpec.

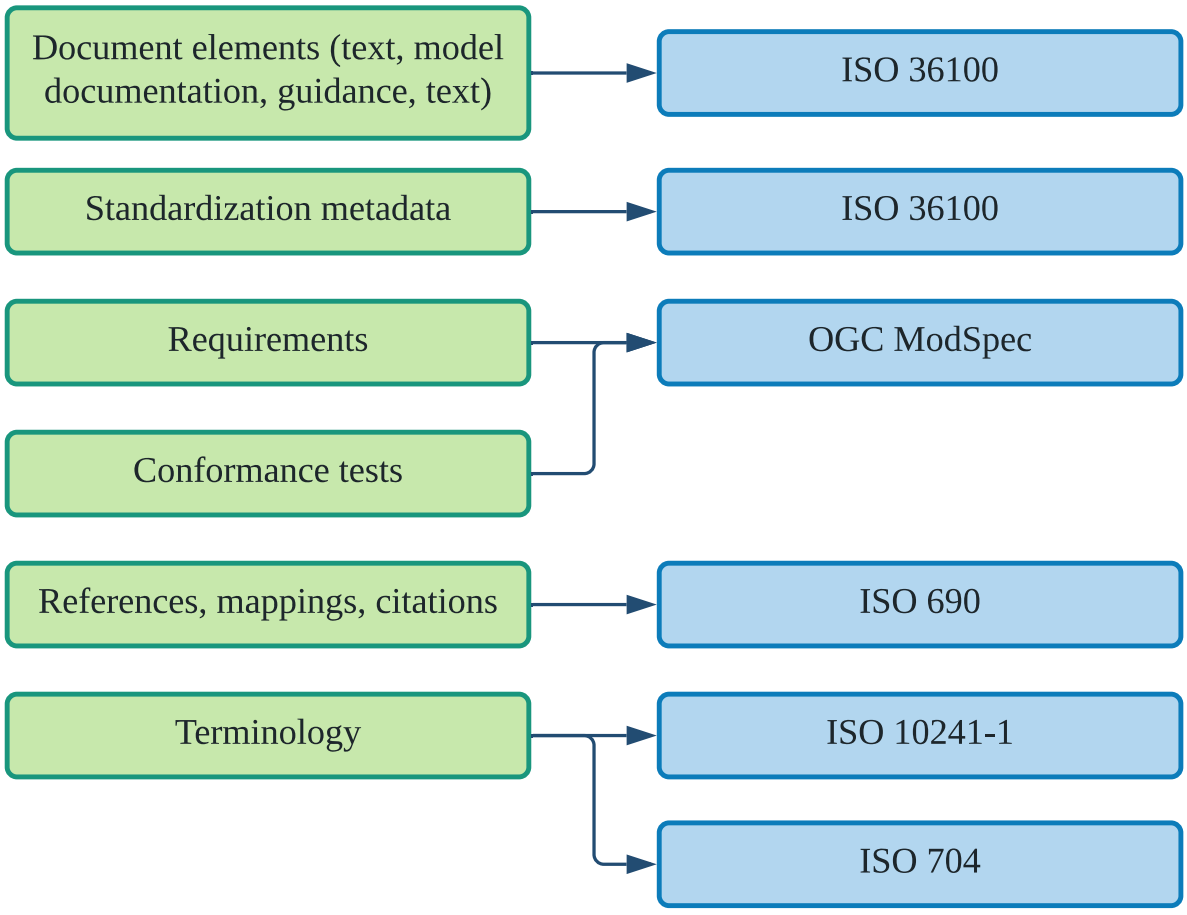


Figure 7 — Models used in Metanorma

7.6. LutaML information model interface

LutaML is an initiative grown out of Metanorma that allows parsing various machine-interpretable information models. LutaML adopts an extensible processing architecture to allow parsing different information model languages, through LutaML extensions.

Supported LutaML extensions include the following.

- EXPRESS, as specified in ISO 10303-11, is used heavily in smart manufacturing, Industry 4.0 use cases and in BIM, where EXPRESS itself served as the foundation of the IFC classes. The LutaML EXPRESS extension is available at: https://github.com/lutaml/lutaml-express.
- OMG UML in OMG XMI, which is the canonical format of representing UML models within XMI, an XML language defined by OMG OMG XMI 2.5.1. The LutaML XMI extension is available at: https://github.com/lutaml/lutaml-xmi.
- Sparx Systems Enterprise Architect XMI, the proprietary extension of Sparx Systems Enterprise Architect for the representation of UML. The LutaML Enterprise Architect-specific XMI extension is implemented within the LutaML XMI extension.
- LutaML UML, which is an ASCII syntax used to author OMG UML-compliant UML models with the possibility to be exported into OMG XMI format. The LutaML UML extension is available at: https://github.com/lutaml/lutaml-uml.

  NOTE: The LutaML UML language is documented at https://github.com/lutaml/lutaml-uml/blob/master/LUTAML.adoc

LutaML supports the dynamic referencing of elements from within a UML model. For example, individual UML classes, attributes, stereotypes, Enterprise Architect diagrams, can all be referenced through the unified interface provided by LutaML.

Collection filtering, such as to find UML classes that match certain UML stereotype, is also supported.

LutaML-XMI is the LutaML extension that parses OMG XMI 2.5.1 into a LutaML-UML model.

Of course, each format that it reads in requires a separate plug-in to be written to process it, and the processing of different formats can be highly specialized work. That makes it important for MDA to coalesce around standard ways of expressing models as much as possible, to minimize the up-front effort of developing a new plug-in to read a new model format.

The LutaML-XMI plug-in supports parsing the proprietary XMI files generated by Sparx Systems Enterprise Architect, incorporating details only available in the vendor proprietary XML portion of the XMI file.

This plug-in has been successful in recognizing the classes it expresses, their attributes, and the relations between classes, as documented in OGC 21-035r1.

7.7. Metanorma LutaML plugin

Metanorma interfaces with information models through the Metanorma LutaML plugin (https://github.com/metanorma/metanorma-plugin-lutaml). This plugin is used to render information models in human-readable formatting for MDS.

The plugin provides a set of commands to be used within a Metanorma authoring context that invokes LutaML processing of a specified file, which generates a representation of that data usable within Metanorma.

Model navigation, dynamic referencing and collection filtering capabilities to UML models are accessible within a Metanorma document through the corresponding LutaML commands.

By default, LutaML is invoked to parse an external information model through a Metanorma AsciiDoc block command, which requires the input of the following information:

- as an argument, name of the source information model file;
- as an argument, the named context, which is the object variable name into which the data file contents are parsed, as object attributes, recursively; and
- as the contents of the block, a template, in Metanorma AsciiDoc format with the Liquid template language (https://shopify.github.io/liquid/).

In effect, this provides a “meta-authoring” environment from within Metanorma. In particular, the template language allows the attributes parsed by LutaML to be incorporated in the block under the command.

8

BASICS OF ENTERPRISE ARCHITECT

8 BASICS OF ENTERPRISE ARCHITECT

8.1. Launch screen

Once the EA application is launched with a model file, the screen is shown as in Figure 8.

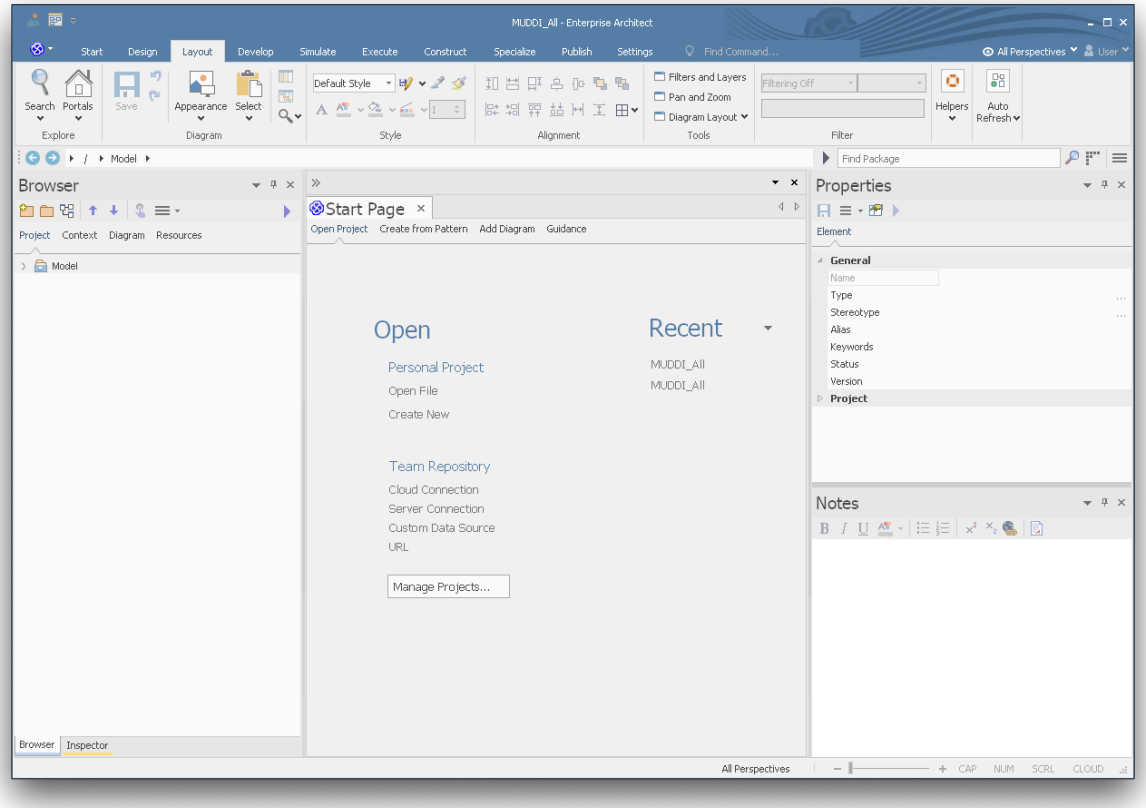


Figure 8 — Launch screen of Enterprise Architect

There are 4 basic panes in this screen.

- Browser: where the UML packages, models and properties are shown and can be navigated.
- Main pane: the area in the middle (labelled with the tab “Start Page”). It is typically used to show and work with diagrams.
- Properties: shows all properties and attributes of the selected UML element, whether it is a figure, package, class or property.

- Notes: shows textual annotations made to the selected UML element.

Relevant best practices:

- In the Notes pane, enter plain text in the Metanorma AsciiDoc format. While the pane supports rich-text entry, the text is encoded in HTML based on the antiquated Microsoft RTF format, and makes it difficult to perform any post processing upon extraction.

8.2. Using the Browser pane

The top-level package in the Enterprise Architect file can be expanded and drilled-down into.

Figure 9 shows how the hierarchy looks like.

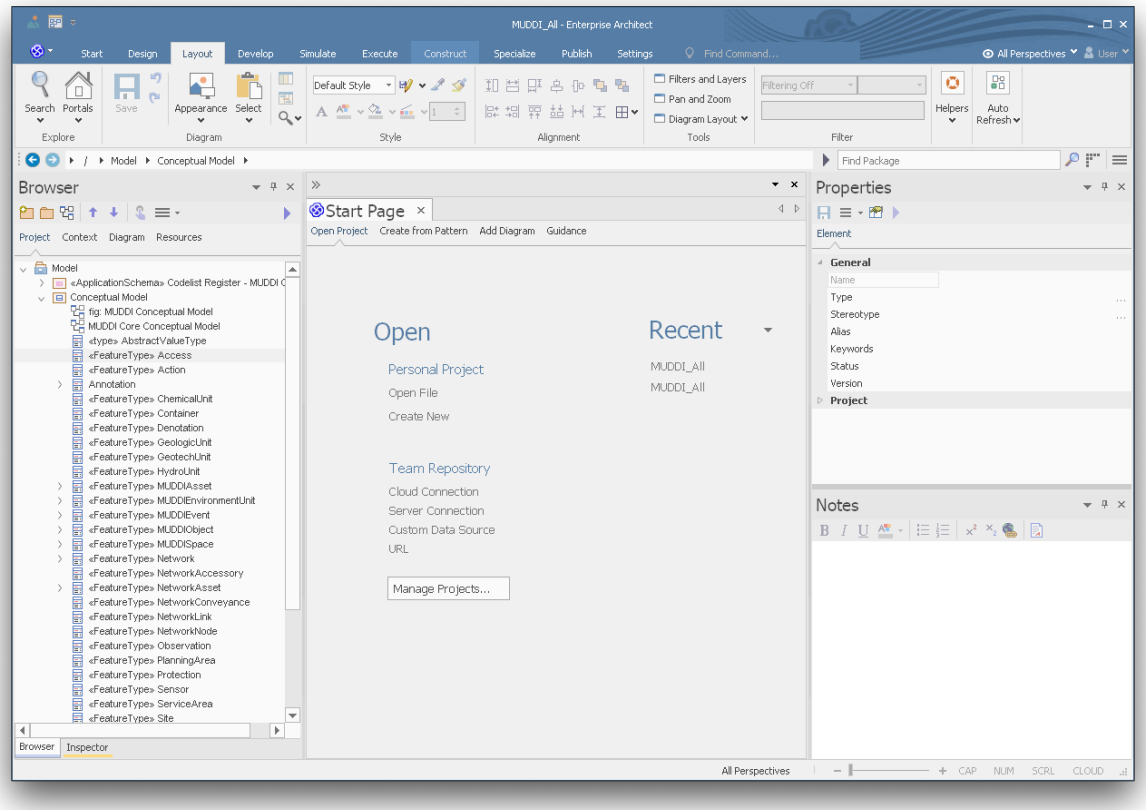


Figure 9 — Example of expanding the UML model hierarchy (source: MUDDI)

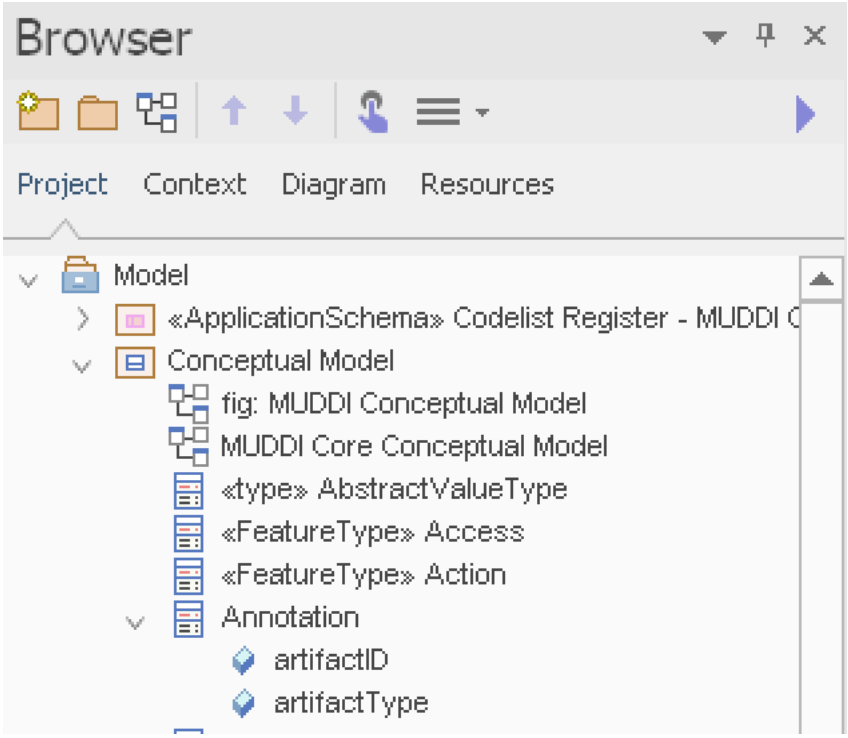


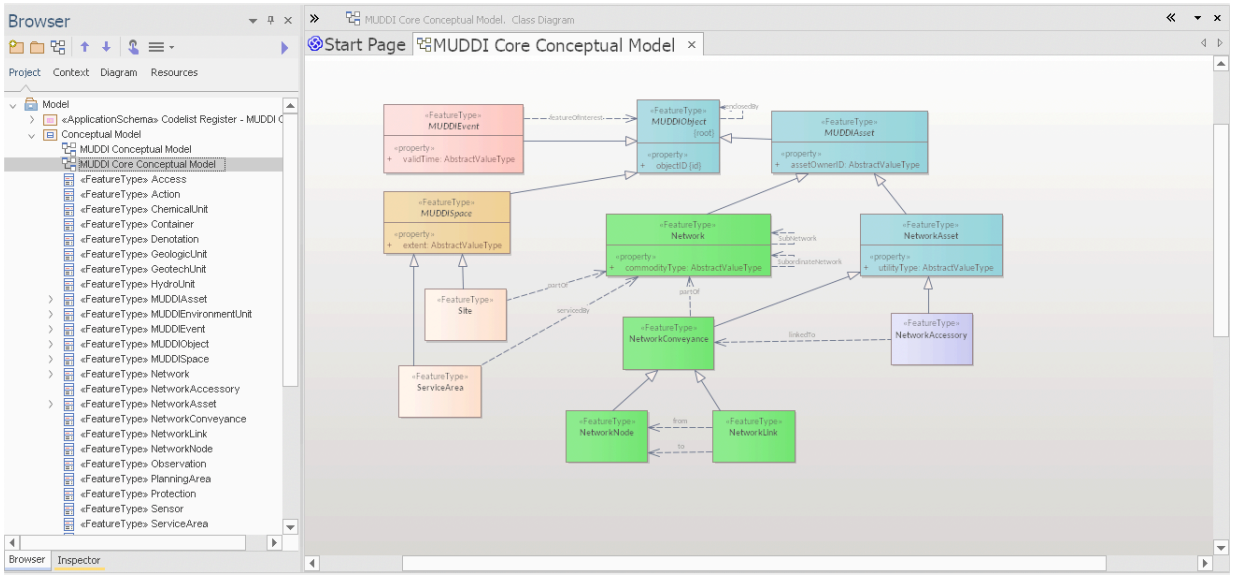
Figure 10 — Browser item types

In the Browser, there are 4 (basic) types of elements seen in its hierarchy (see Figure 10).

- Packages: UML packages.
  - The top-level item shown in Figure 9 is a UML package called “Model”.
  - The second item is a UML package called “Conceptual Model”.
- Diagrams: UML diagrams.
  - The 3rd and 4th items named: “fig: MUDDI Conceptual Model” and “MUDDI Core Conceptual Model” are figures.
- Classes: UML classes.
  - The 5th to 8th items are all UML classes.
- Property: UML element property.
  - The 9th to 10th items are UML properties that belong to the class “Annotation”.

8.3. Diagrams

When opening a diagram from the Browser pane, a tab will be opened in the middle pane showing the UML diagram (see Figure 11).



NOTE: The UML diagram can be zoomed into via the "View" action in the ribbon tab.

Figure 11 — UML diagram in EA

When a diagram is selected in the Browser, the Properties and Notes panes will be changed to reflect information about the selected diagram.

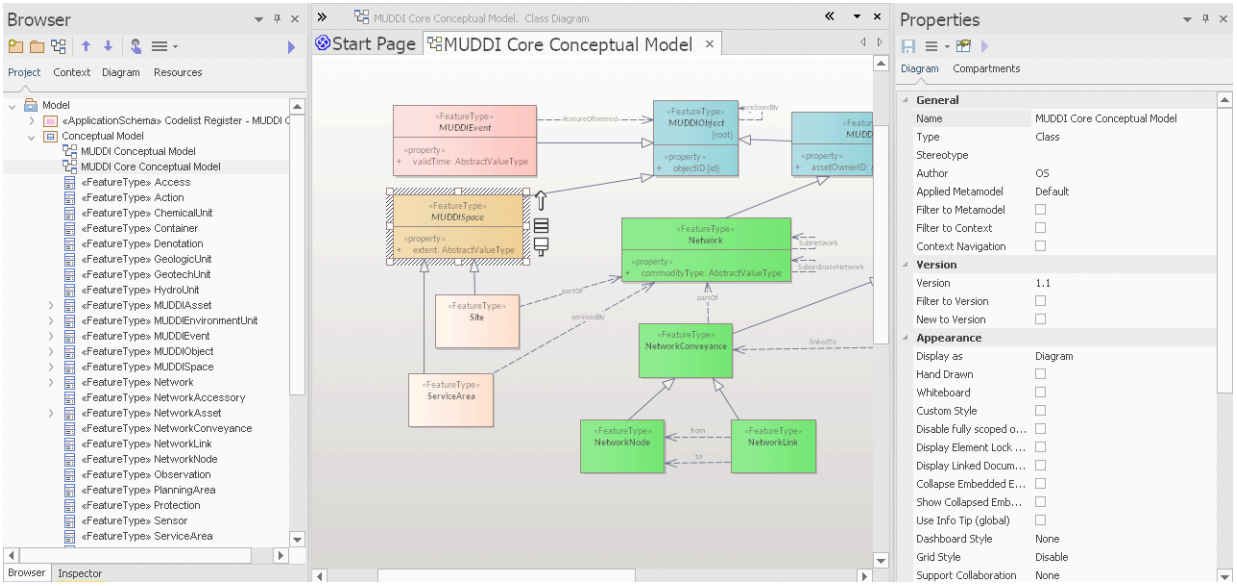


Figure 12 — UML diagram in EA with Properties pane open

The MDS process uses the following information from an EA UML Class Diagram.

- Graphics of the diagram: is exported in the vector format and included in the OGC deliverable.
- Title of the diagram: as the caption of the Figure in the OGC deliverable.
- Notes of the diagram: contents of the Notes (seen in the Notes pane) is used as a “NOTE to Figure” in the OGC deliverable.

The title of the diagram is edited within the Properties pane when the diagram is selected. See Figure 13.

Model authors commonly create multiple diagrams but only wish to selectively include diagrams in the MDS process.

By default, all diagrams are included as figures. In order to skip a diagram, the prefix “Spare: ” or “old: ” can be given to the diagram name to exclude the diagram from the MDS generation process.

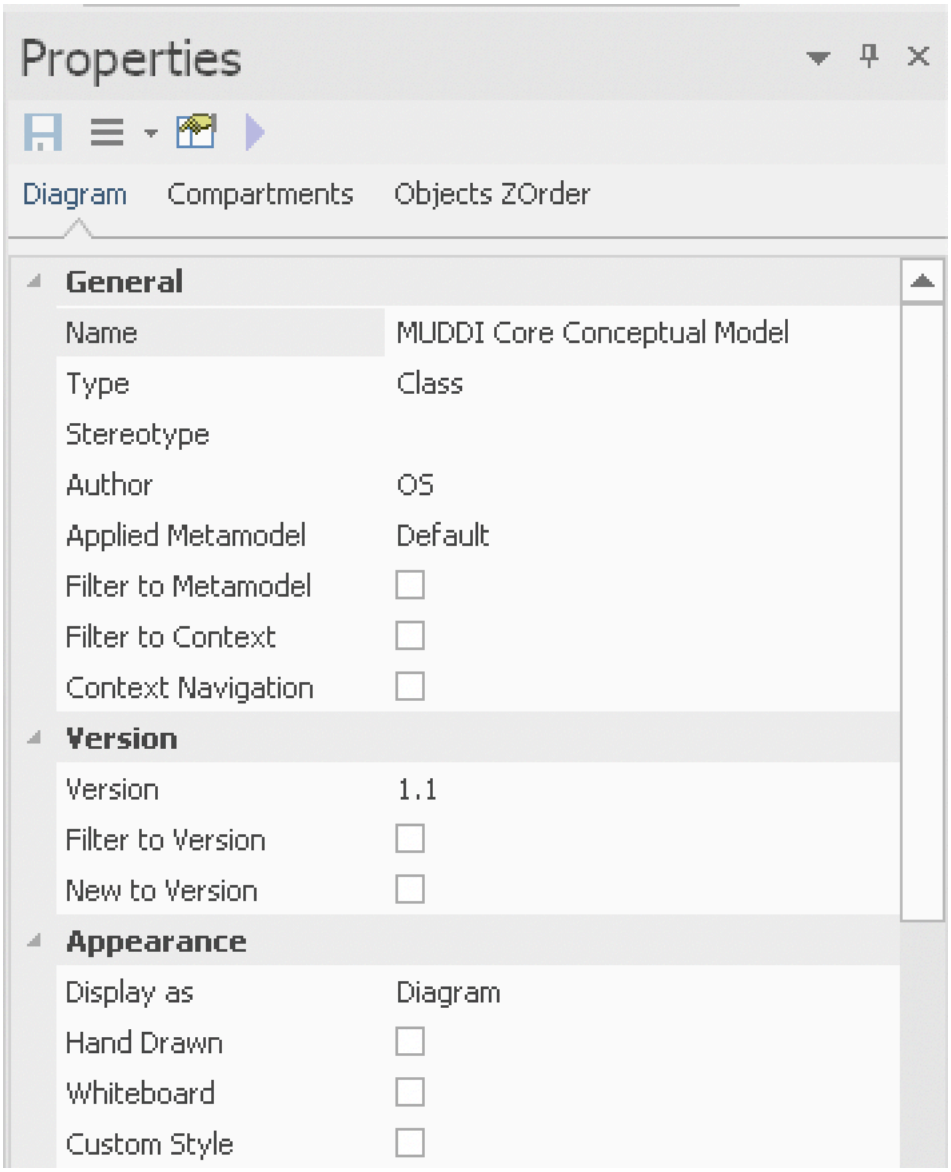


Figure 13 — EA Diagram Properties pane

8.4. Packages

On selection of a UML Package, the Properties and Notes panes will reflect the selected item.

The MDS process incorporates information of the UML Package, including:

- Notes of the UML Package: as the definition (description) of the UML Package (as in the Notes pane) (see Figure 14);
- Name of the UML Package: name of the UML Package is used as the clause heading in the OGC deliverable (see Figure 15); and

- Package details:
  - URI: Identifier in URI format; and
  - “Visibility”: `Public`, `Private`, `Protected` or `Package` visibility.

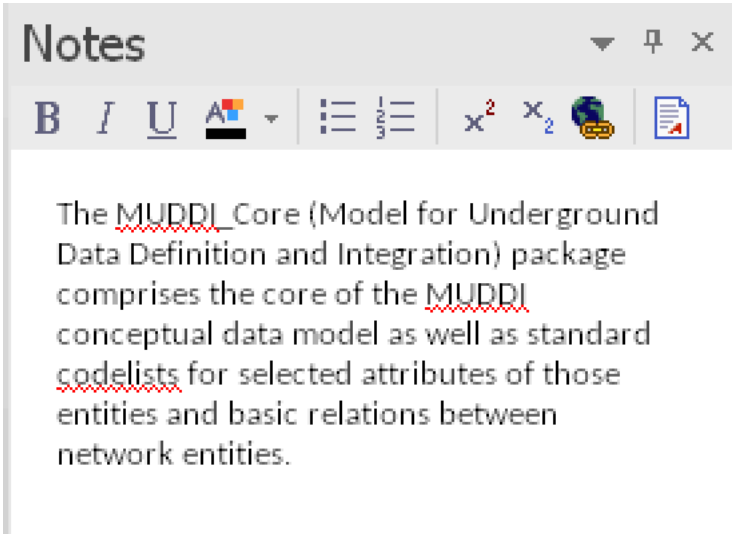


Figure 14 — EA UML package Notes pane

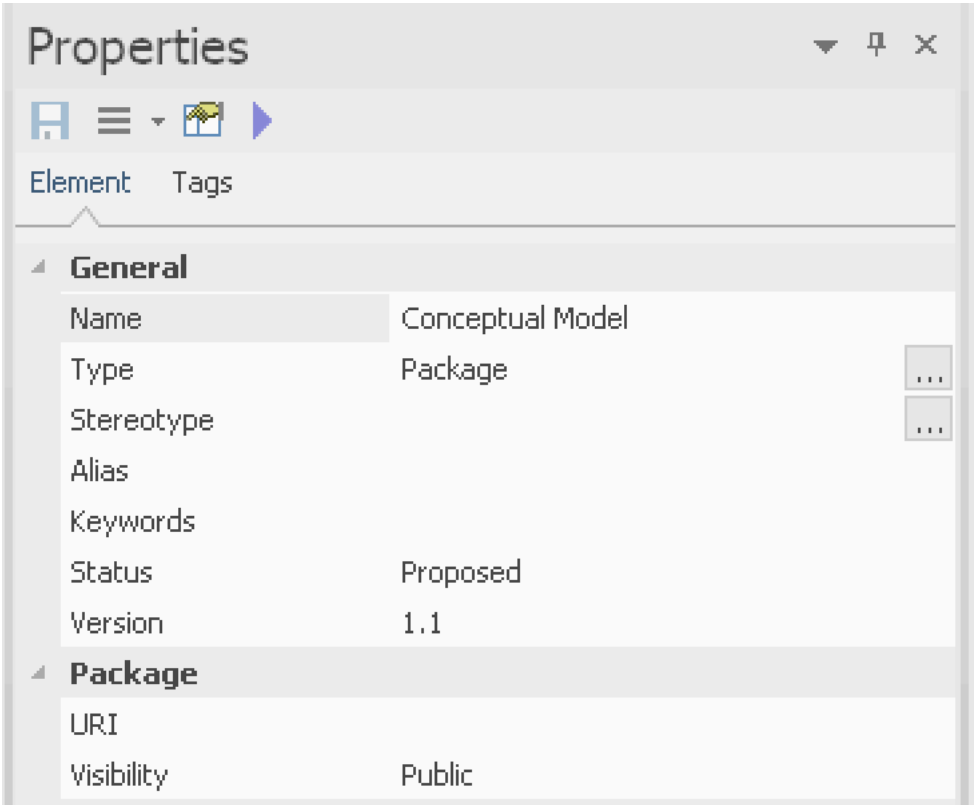


Figure 15 — EA UML package Properties pane

8.5. Classes

On selection of a UML Class in the Browser pane, the Properties and Notes panes will reflect the selected item.

The MDS process incorporates information of the UML Class, including:

- Notes of the UML class: as the definition (description) of the UML Class (as in the Notes pane) (see Figure 16);
- Name of the UML class: name of the UML class, used as a clause heading in the OGC deliverable (see Figure 17);
- Stereotype of the UML class: stereotype of the UML class, wrapped with « and » characters in the OGC deliverable; and
- Class properties:
  - "Abstract" status: whether it is an Abstract class; and
  - "Visibility": `Public`, `Private`, `Protected` or `Package` visibility.

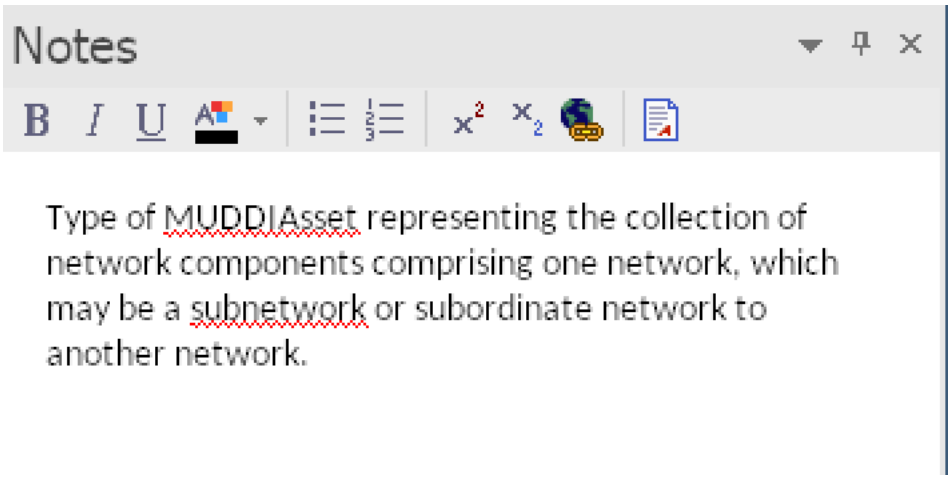


Figure 16 — EA UML class Notes pane

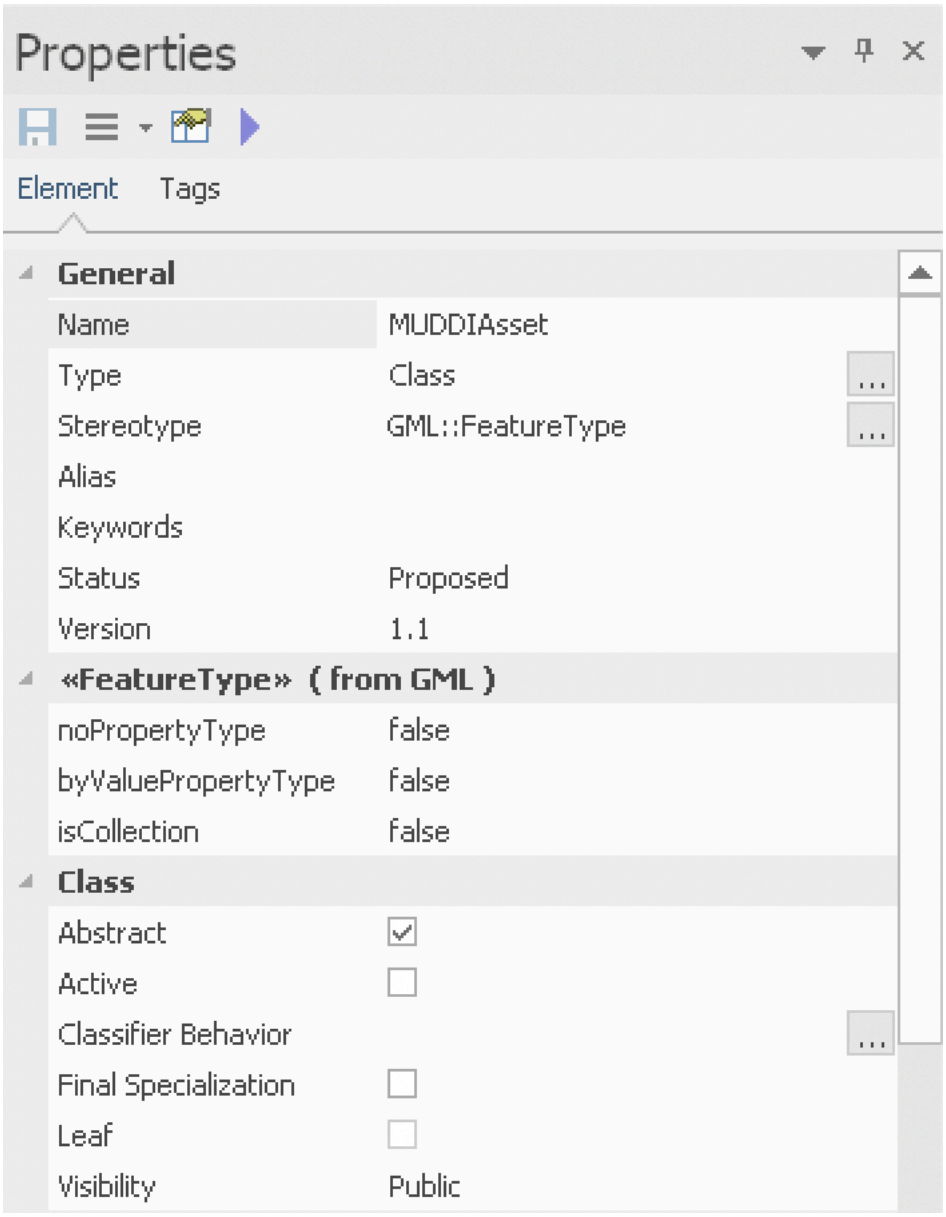


Figure 17 — EA UML class Properties pane

To set Stereotypes, click on the "..." to the right of the Stereotypes row in the Properties pane. A dialog box will be opened to allow selection of Stereotypes.

For geospatial modeling, EA supports setting Stereotypes from the following profiles:

- UML Standard Profile (see Figure 18)
- GML Profile (see Figure 19)

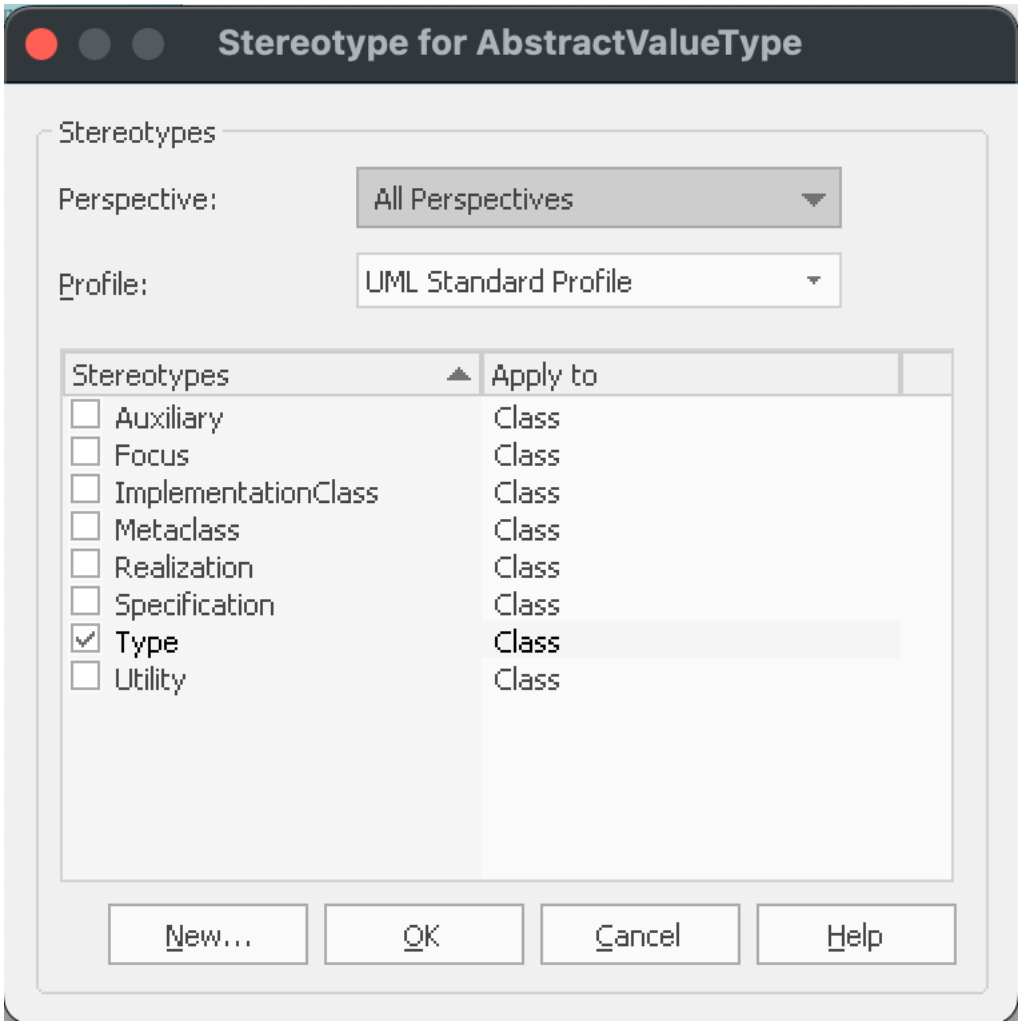


Figure 18 — EA UML Class Stereotypes: UML Standard Profile

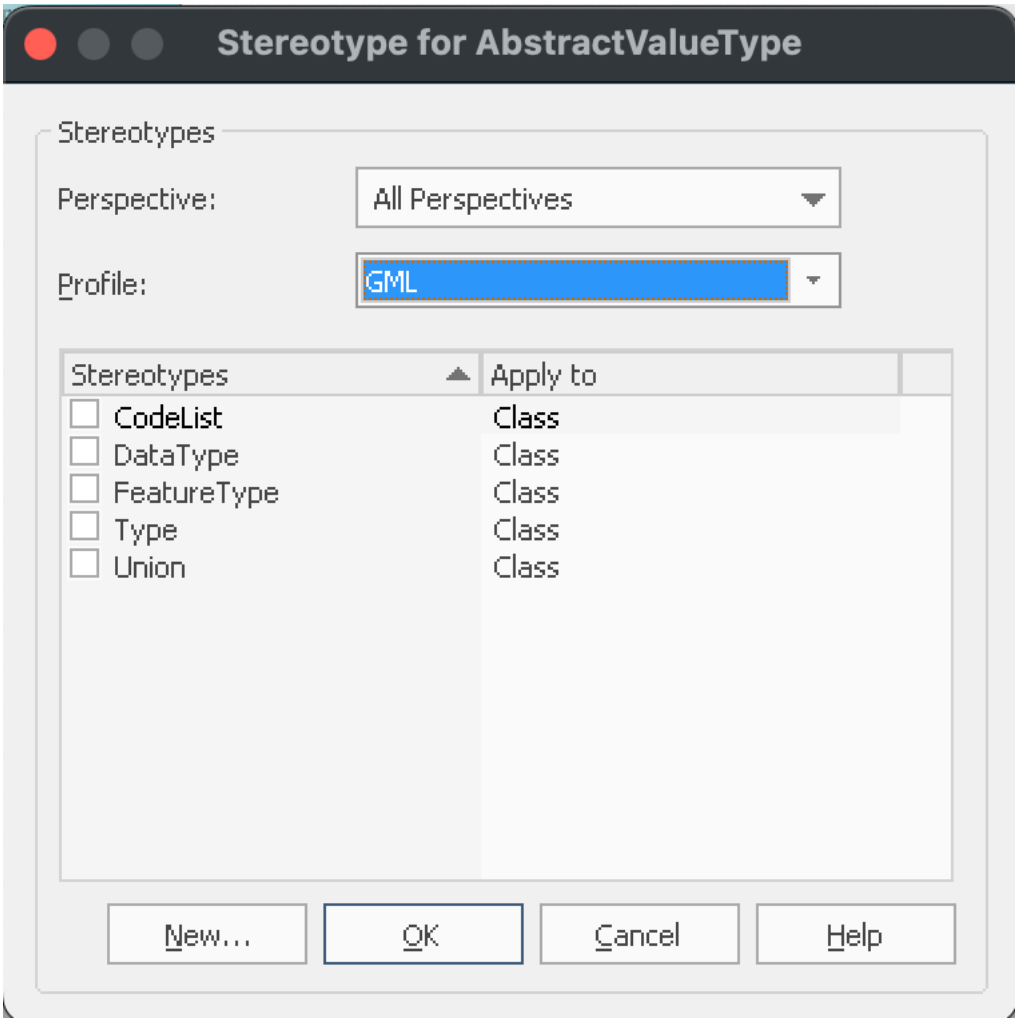


Figure 19 — EA UML Class Stereotypes: GML

Multiplicity requirements at the UML Class level are set using the “Properties” popup window, under the “Details” tab on the right side, as seen in Figure 20.

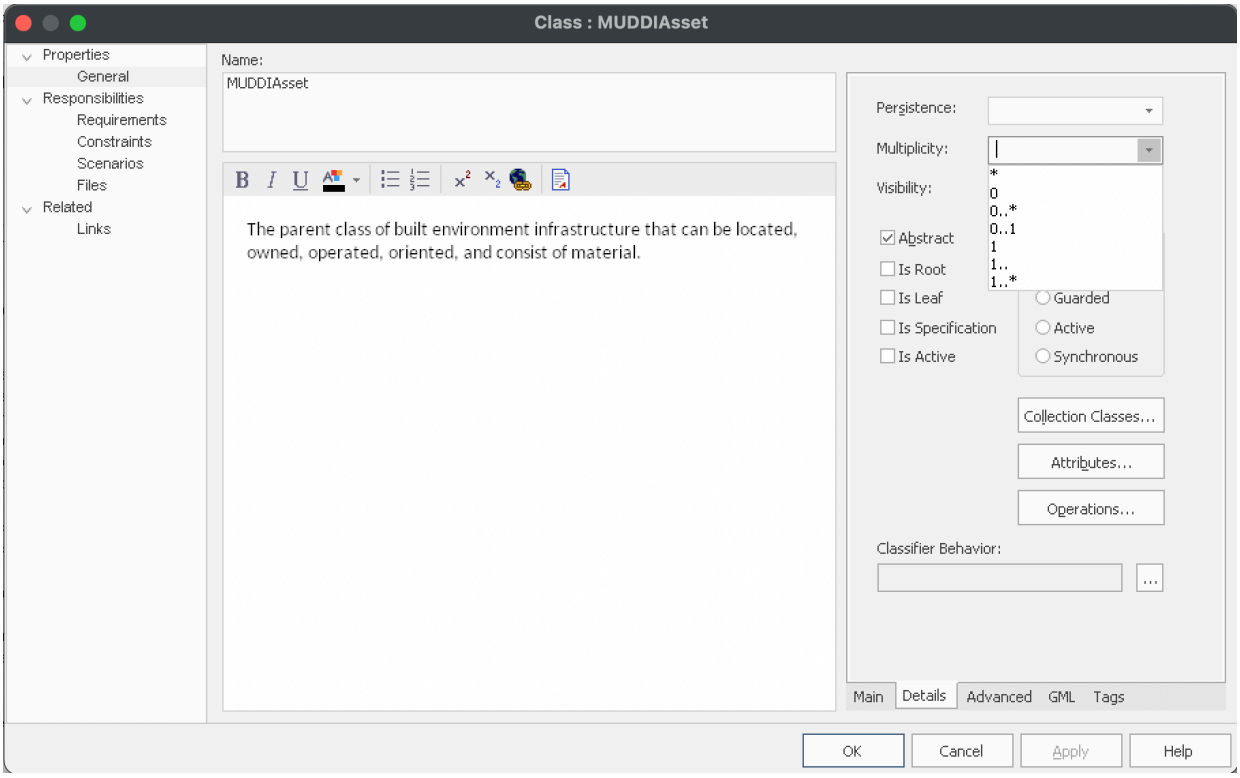


Figure 20 — EA UML Class multiplicity

Constraints on an UML Class are set via the “Properties” popup window, under the “Responsibilities > Constraints” menu item.

- The top left “Constraint:” box is the description of the constraint.
- The box below “Constraint:” is for entering constraint conditions in the constraint language. While EA supports rich text inside the constraint conditions box, it is crucial that the constraints are entered in plain text for the MDS process.
- The top right box “Properties” contains a “Type” item that is used for stating the type of the constraint language. In OGC, model constraints shall be set using OCL, and that “OCL” shall be selected in the “Type” item.

Multiple constraints can be set on an UML class, which they can be individually saved and listed in the bottom pane.

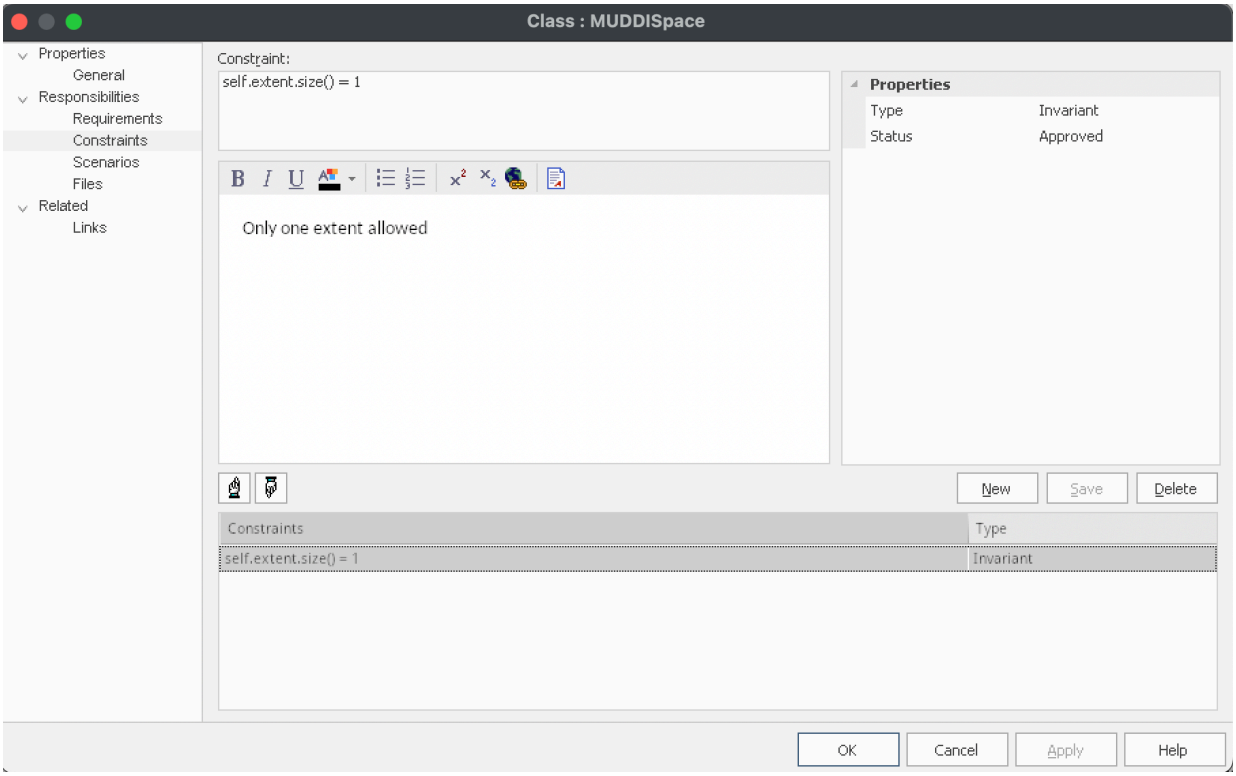


Figure 21 — EA UML Class constraints

8.6. Attributes

On selection of a UML Attribute (under a UML Class), the Properties and Notes panes will reflect the selected item.

The MDS process incorporates information of the UML Attribute, including:

- Notes of the UML Attribute: as the definition (description) of the UML Attribute (as in the Notes pane) (see Figure 22);
- Name of the UML Attribute: name of the UML Attribute, used as a clause heading in the OGC deliverable (see Figure 23);
- Stereotype of the UML Attribute: stereotype of the UML Attribute, wrapped with « and » characters in the OGC deliverable; and
- Attribute details:
  - Initial value: default value if not specified; and
  - Multiplicity: `0`, `1`, `0..1`, `0..`, `1..`, `*`.

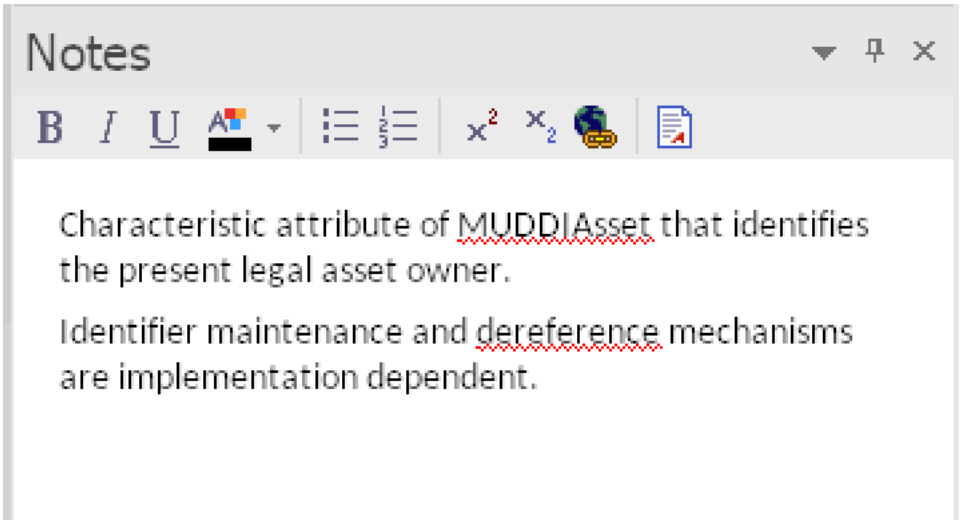


Figure 22 — EA UML attribute Notes pane

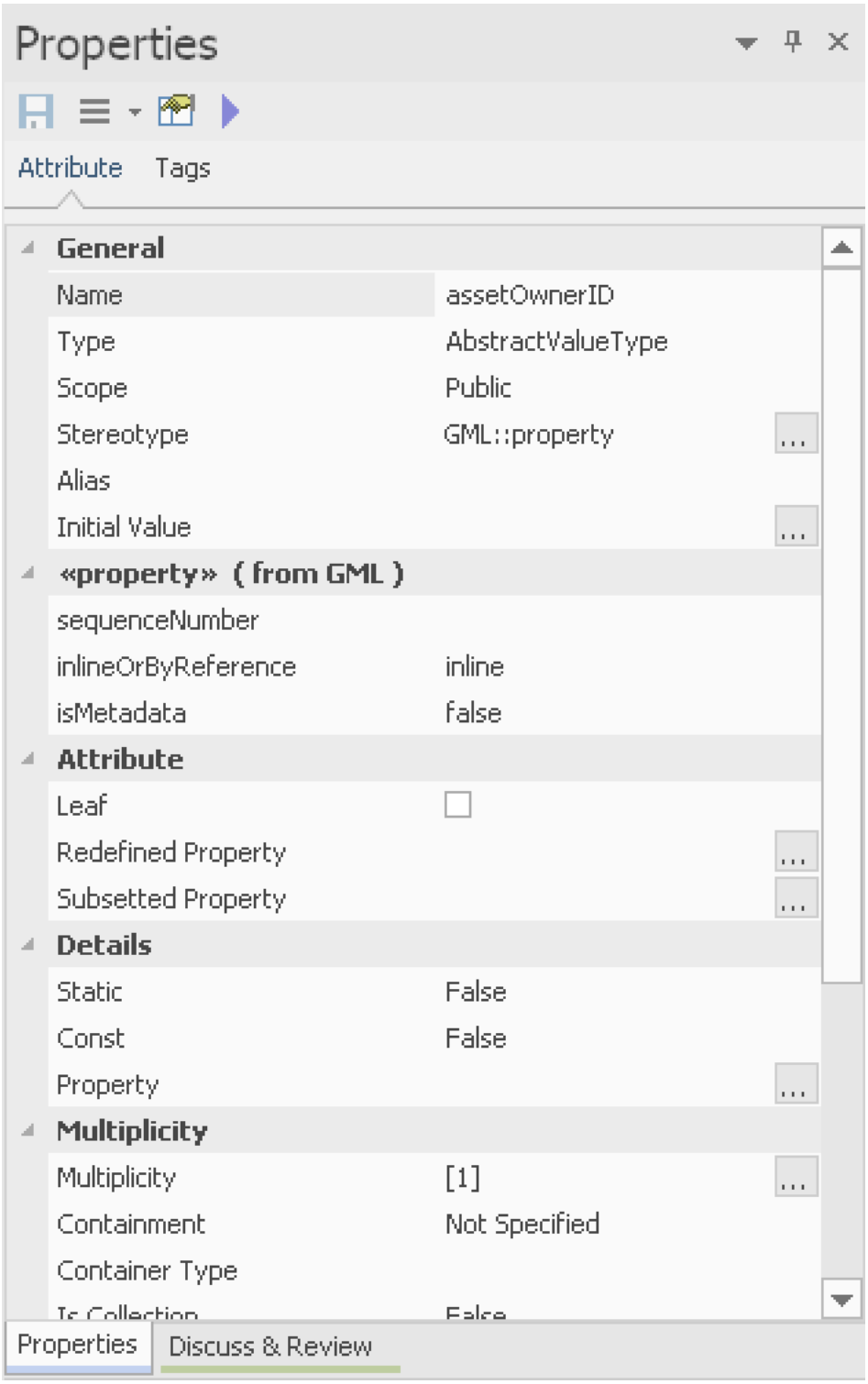


Figure 23 — EA UML attribute Properties pane

Multiplicity requirements at the UML Attribute level are set using the “Properties” pane at the “Multiplicity” item. The “…” at that item opens an additional popup where detailed multiplicity requirements can be set, as seen in Figure 24.

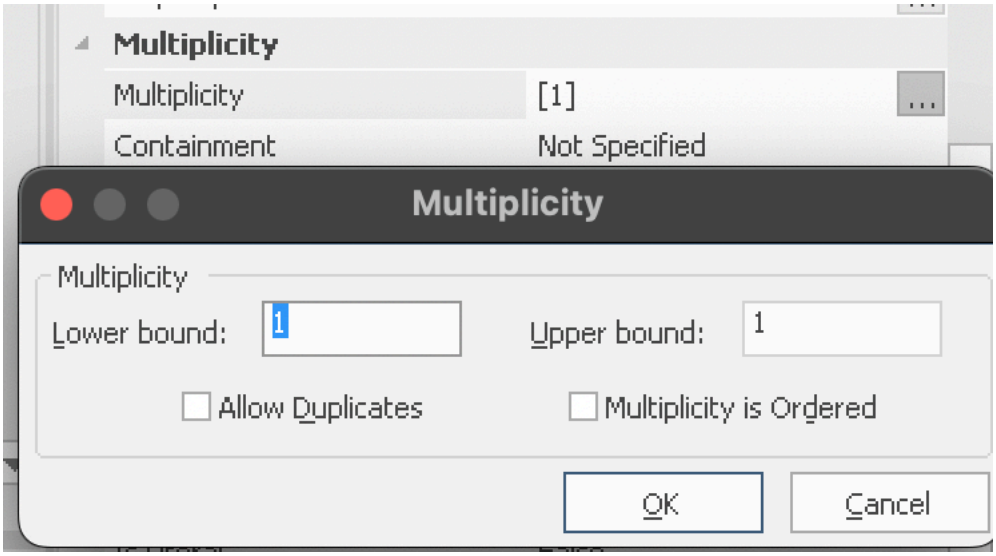


Figure 24 — EA UML Attribute multiplicity

Constraints on an UML Attribute are set via the "Properties" popup window, under the "Constraints" menu item.

- The top left "Constraint:" box is the description of the constraint.
- The top right "Type:" box is a selection for the constraint language.
- The second pane from the top is for entering constraint conditions in the constraint language. In OGC, model constraints shall be set using OCL, and the language selection box shall be set to "OCL".

Multiple constraints can be set on a UML attribute, which they can be individually saved and listed in the lowest pane.

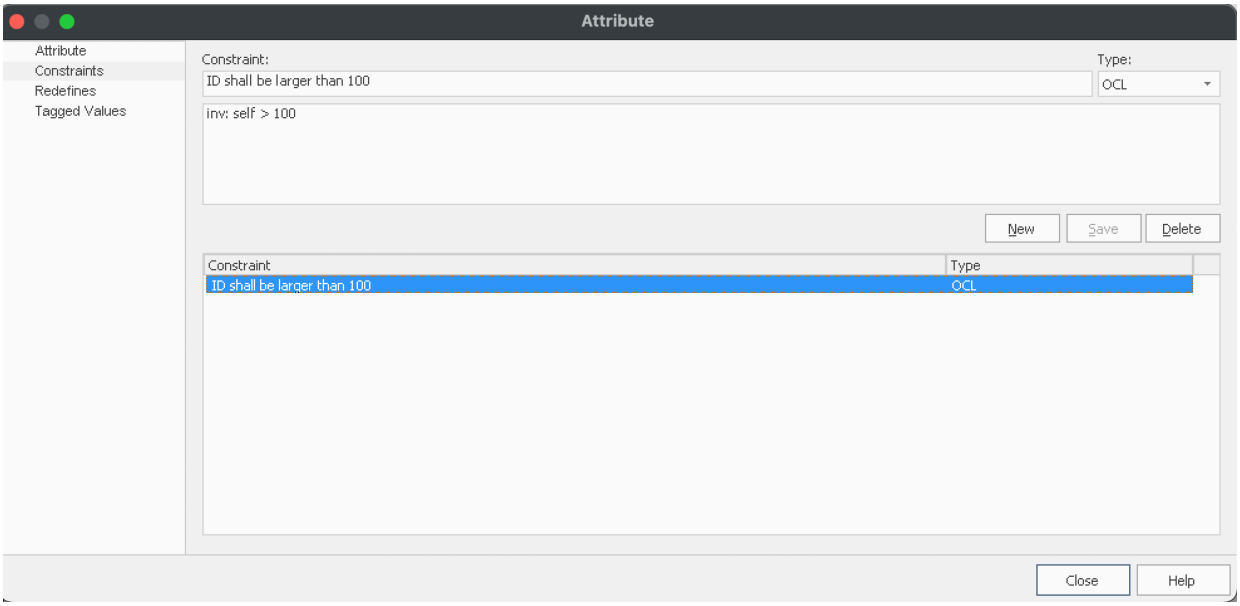


Figure 25 — EA UML attribute constraints

8.7. Data type

A data type is a UML model that define data values and has no operations.

The operations that can be done on a UML Data Type are nearly identical to that of the UML Class.

The MDS process incorporates information of the UML Data Type, including:

- Notes of the UML Data Type: as the definition (description) of the UML Data Type (as in the Notes pane) (see Figure 26);
- Name of the UML Data Type: name of the UML Data Type, used as a clause heading in the OGC deliverable (see Figure 27);
- Stereotype of the UML Data Type: stereotype of the UML class, wrapped with « and » characters in the OGC deliverable; and
- Data Type properties:
  - "Abstract" status: whether it is an Abstract Data Type; and
  - "Visibility": `Public`, `Private`, `Protected` or `Package` visibility.

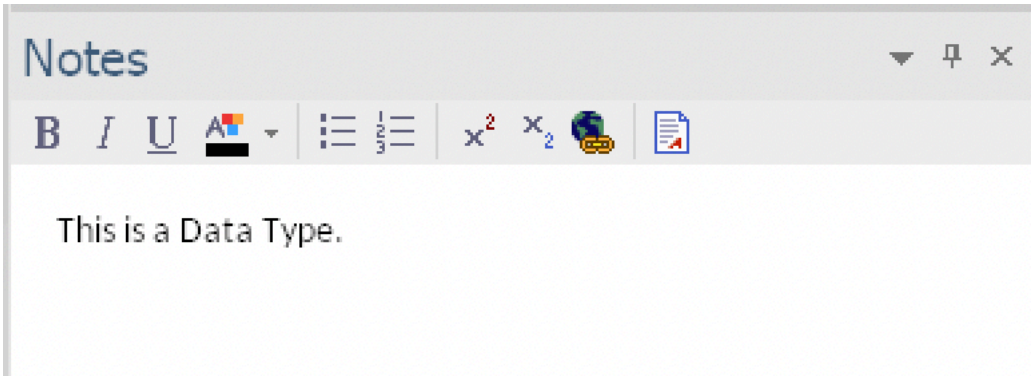


Figure 26 — EA UML data type Notes pane

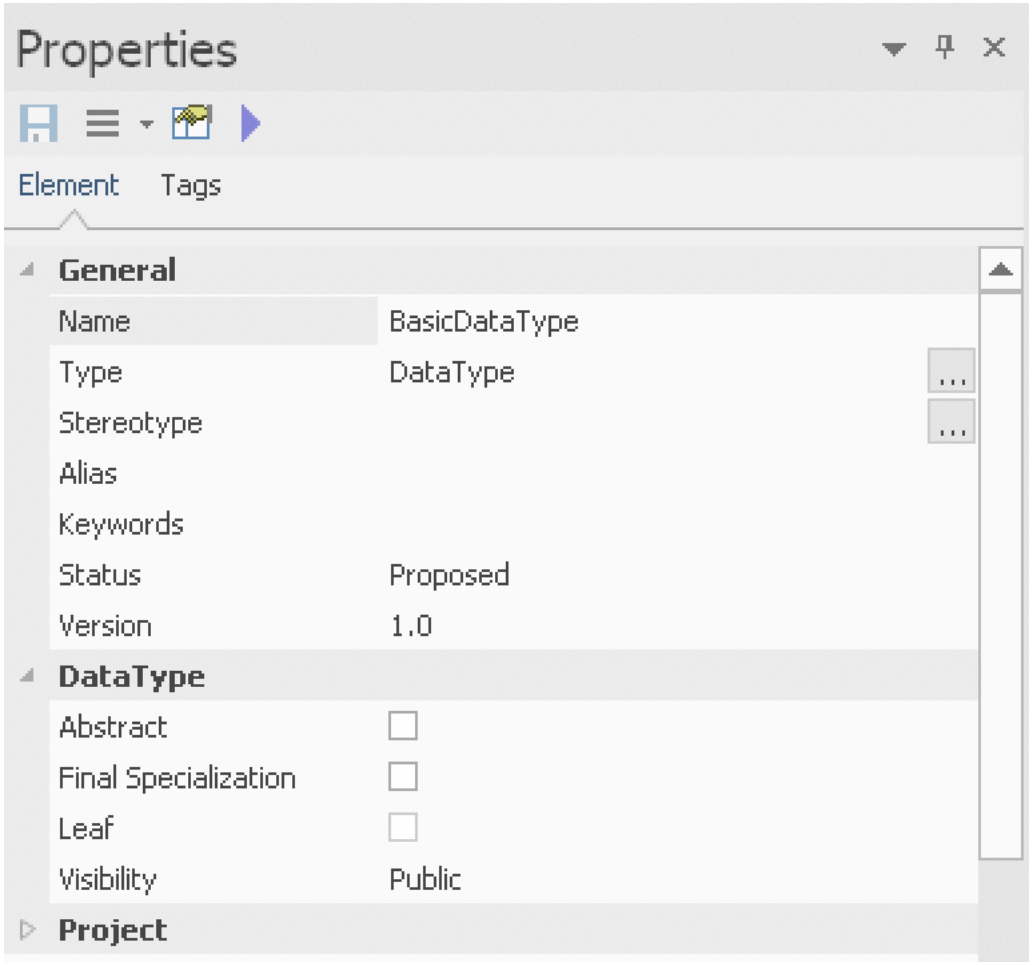


Figure 27 — EA UML data type Properties pane

The method to set the following properties of UML Data Type are identical to that of UML Classes:

- stereotypes;
- multiplicity;

- constraints.

8.8. Enumeration

An enumeration is a UML model used to define data values.

The operations that can be done on an UML Enumeration are nearly identical to that of the UML Data Type.

The MDS process incorporates information of the UML Enumeration, including:

- Notes of the UML Enumeration: as the definition (description) of the UML Enumeration (as in the Notes pane) (see Figure 28);
- Name of the UML Enumeration: name of the UML Enumeration, used as a clause heading in the OGC deliverable (see Figure 29);
- Stereotype of the UML Enumeration: stereotype of the UML class, wrapped with « and » characters in the OGC deliverable; and
- Enumeration properties:
  - "Abstract" status: whether it is an Abstract Enumeration; and
  - "Visibility": `Public`, `Private`, `Protected` or `Package` visibility.

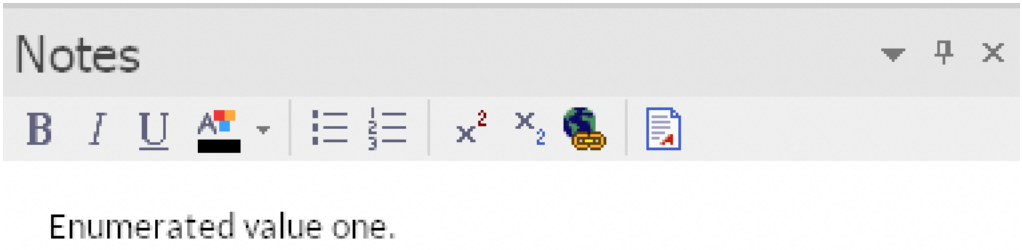


Figure 28 — EA UML Enumeration Notes pane

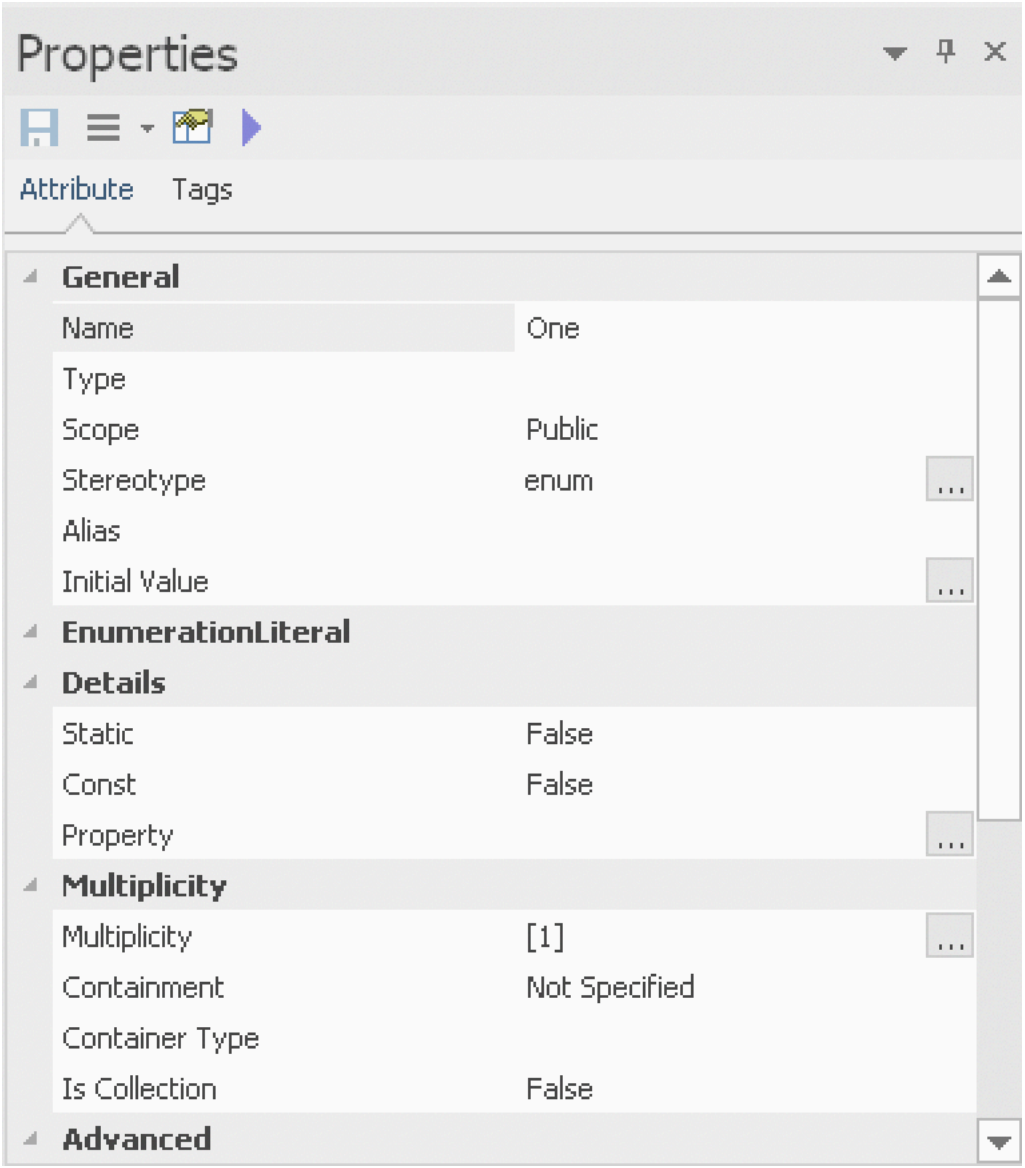


Figure 29 — EA UML Enumeration Properties pane

The method to set the following properties of UML Enumeration are identical to that of UML Classes:

- stereotypes;
- multiplicity; and
- constraints.

8.9. Enumeration value

Enumerations can contain Enumerated Values.

The operations that can be done on an UML Enumerated Value are nearly identical to that of the UML Attribute.

The MDS process incorporates information of the UML Enumerated Value, including:

- Notes of the UML Enumerated Value: as the definition (description) of the UML Enumerated Value (as in the Notes pane) (see Figure 30);
- Name of the UML Enumerated Value: name of the UML Enumerated Value, used as a clause heading in the OGC deliverable (see Figure 31); and
- Stereotype of the UML Enumerated Value: stereotype of the UML class, wrapped with « and » characters in the OGC deliverable.

Figure 30 — EA UML Enumerated Value Notes pane

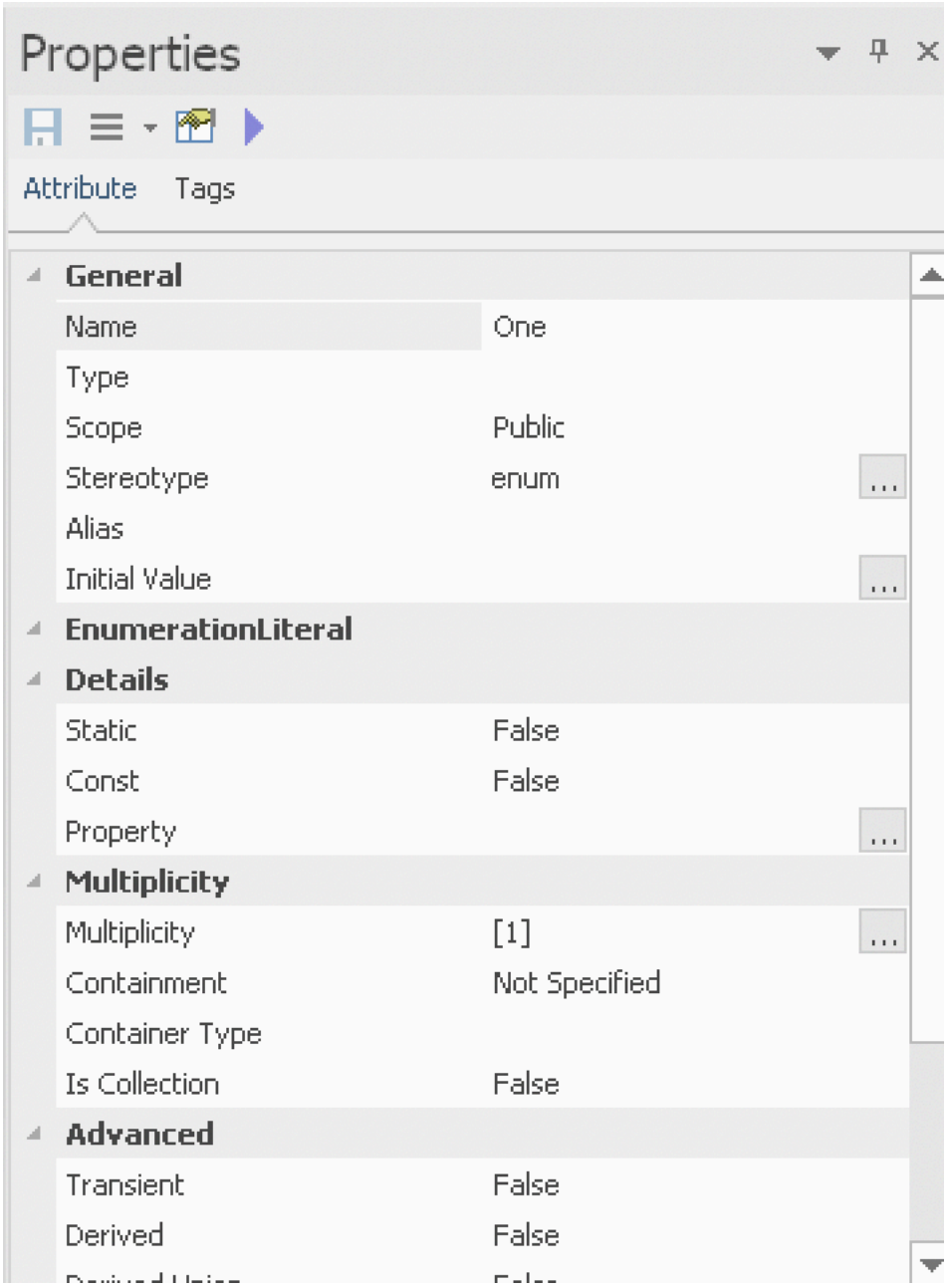


Figure 31 — EA UML Enumerated Value Properties pane

The method to set the following properties of UML Enumerated Value are identical to that of UML Attributes:

- stereotypes;
- multiplicity; and
- constraints.

An Enumerated Value can be assigned a data type in the “Properties” popup, under the menu item “Attribute”, as shown in Figure 32.

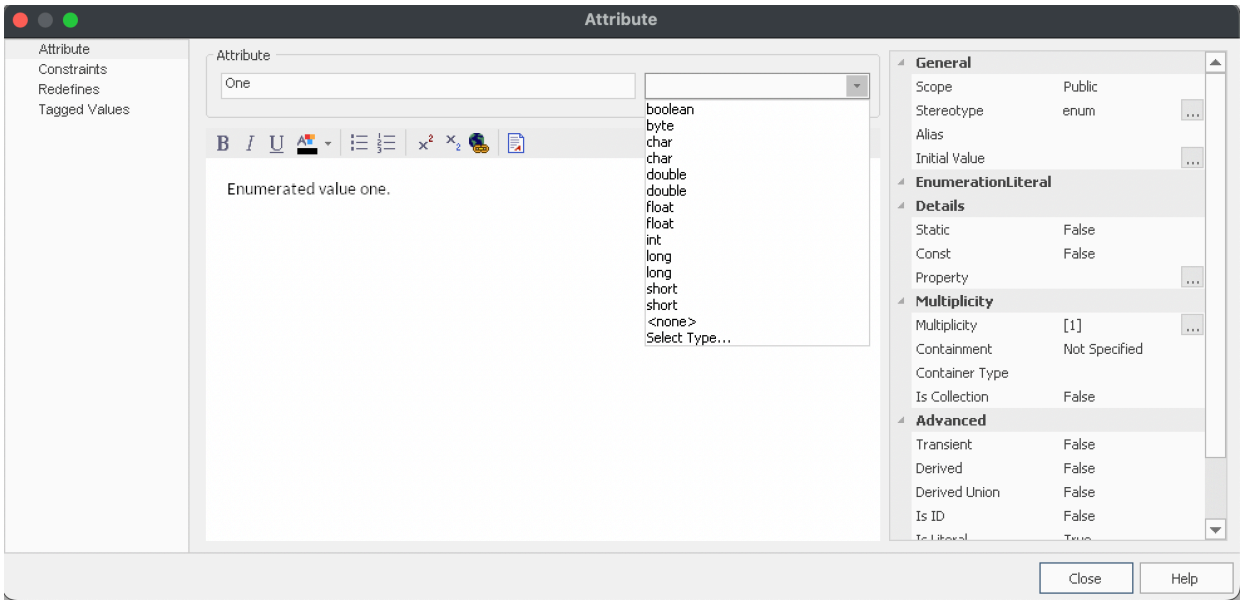


Figure 32 — EA UML Enumerated Value Properties popup

9

BASICS OF METANORMA

9 BASICS OF METANORMA

9.1. General

Metanorma uses a syntax called Metanorma AsciiDoc, which is based on the AsciiDoc format with a number of extensions.

An OGC Metanorma document is composed of two parts:

- Metadata
- Content body

9.2. Encoding

9.2.1. Metadata

9.2.1.1. General

The metadata portion is composed of the document header and attributes.

In Metanorma AsciiDoc, the metadata portion is made up of two types of information, the preamble and document attributes.

The preamble is the section from the first line in the document until the first document attribute.

The document title is the first line of the document prefixed with one = (equal) sign.

```
= OGC MUDDI Conceptual Model
```

Figure 33 — Document title syntax (from OGC MUDDI Conceptual Model)

While typical AsciiDoc supports author information, revision date and a version number in the preamble, their usage is discouraged in Metanorma because of the limited semantics supported. Metanorma AsciiDoc instead uses document attributes to encode such information.

A document attribute represents a piece of metadata in the document that is not immediately rendered. They can be thought of variable assignments or arguments in the document that are needed for a particular document type.

A document attribute is a variable composed of alphanumeric characters, the _ (underscore) or – (hyphen) symbols, wrapped between the : (colon) symbol.

The following syntax demonstrates assigning the mandatory attributes called the `:doctype:` and `:docsubtype:`, which defines the type and subtype of the OGC deliverable. For a full list of supported (mandatory and optional) attributes, please refer to the Metanorma for OGC reference.

```
:doctype: standard
:docsubtype: conceptual-model
```

Figure 34 — Document attribute syntax (from OGC MUDDI Conceptual Model)

An example of a complete metadata portion is shown below.

Example — Sample Metanorma AsciiDoc metadata (from OGC MUDDI Conceptual Model)

```
= OGC MUDDI Conceptual Model
:doctype: standard
:docsubtype: conceptual-model
:language: en
:status: draft
:committee: technical
:docnumber: 22-999
:received-date: 2023-01-01
:issued-date: 2023-01-01
:published-date: 2023-01-01
:external-id: http://www.opengis.net/doc/XXX/YYYYY
:keywords: ogcdoc, OGC document, MDA, model-driven
:mn-document-class: ogc
:imagesdir: images
:mn-output-extensions: xml,html,pdf,doc,rxl
```

9.2.1.2. Metanorma instructions

The following lines specify that this document is an OGC document, and it should render the various specified types of output, including XML, HTML, PDF, Word and RXL. RXL refers to the Relaton XML format which is used for encoding bibliographic information, and is required for the Metanorma site generation functionality.

The `:imagesdir:` attribute indicates that all images are located under that path, when using the `image::{path}[]` directive.

```
:mn-document-class: ogc
:mn-output-extensions: xml,html,pdf,doc,rxl
:imagesdir: images
```

Figure 35 — Metanorma instruction attributes (from OGC MUDDI Conceptual Model)

9.2.1.3. Document type and sub-types

OGC has an extensive list of document types and some of them require specification of sub-types.

Please refer to Metanorma for a full list of these values. If there is no sub-type for the document type, do not specify a sub-type.

```
:doctype: standard
:docsubtype: conceptual-model
```

Figure 36 — Document type attributes (from OGC MUDDI Conceptual Model)

9.2.1.4. Document status

OGC document types are processed through different approval procedures, and this attribute encodes the status of a document.

Please refer to Metanorma for the list of statuses available for the particular document type. Invalid statuses will result in warnings during document generation.

```
:status: draft
```

Figure 37 — Document status attributes (from OGC MUDDI Conceptual Model)

9.2.1.5. Document identification

OGC documents are uniquely identified via two aspects.

- OGC document number. This unique number is obtained from the OGC portal through a reservation process, in a pattern of `nn-mmm`.

  NOTE: `nn` refers to the year when the document number is reserved, and `mmm` is a sequential number reflecting the number of documents in that year prior to reservation.

- OGC unique identifier. This identifier is called the `external-id` in Metanorma. This identifier typically has the pattern like `xxx/yyy`, and is required to be unique across OGC.

```
:docnumber: 22-999
:external-id: http://www.opengis.net/doc/XXX/YYYYY
```

Figure 38 — Document identification attributes (from OGC MUDDI Conceptual Model)

9.2.1.6. Document provenance

An OGC document is typically developed under the scope of the OGC Technical Committee.

```
:committee: technical
```

Figure 39 — Document provenance attributes (from OGC MUDDI Conceptual Model)

9.2.1.7. Document dates

The OGC standards development process specifies several approval related dates. These dates need to be encoded as they pass through those stages.

```
:received-date: 2023-01-01
:issued-date: 2023-01-01
:published-date: 2023-01-01
```

Figure 40 — Document date attributes (from OGC MUDDI Conceptual Model)

9.2.1.8. OGC keywords

OGC requires all documents to have keywords specified for the purpose of enabling user discovery.

```
:keywords: ogcdoc, OGC document, MDA, model-driven
```

Figure 41 — OGC keyword (from OGC MUDDI Conceptual Model)

9.2.2. Body

9.2.2.1. General

An OGC document has certain fixed and mandatory sections.

For a conceptual model document, it includes the following clauses:

- Prefatory sections
- Clause 1: Scope
- Clause 2: Conformance
- Clause 3: Normative references
- Clause 4: Terms and definitions
- Clause 5 onwards: content body
- Annexes (optional)
- Bibliography

9.2.2.2. Prefatory sections

An OGC deliverable mandates the following prefatory sections.

Abstract	a short summary describing the information provided in the OGC deliverable.
Preface	introductory material that provides the reader with sufficient background on the OGC deliverable.
Submitters	lists out OGC member organizations and their representatives that support the adoption of the OGC deliverable, listed with their respective roles in the development of the OGC deliverable.

The prefatory sections are encoded as shown in Figure 42.

```
[abstract]
== Abstract

Enter the abstract for this document.

== Preface

Enter the preface for this document.

== Submitters

All questions regarding this document should be directed to the editor or the
contributors:

[options="header"]
|===
| Name | Organization | Role

| Given-name-1 Last-name-1 | Organization-1 | Editor
| Given-name-2 Last-name-2 | Organization-2 | Editor
| Given-name-3 Last-name-3 | Organization-3 | Editor

|===
```

Figure 42 — Preface sections in Metanorma AsciiDoc

9.2.2.3. Scope

The scope describes the purpose of the document in succinct terms.

```
== Scope

This OGC Standard provides...
```

Figure 43 — Scope in Metanorma AsciiDoc

9.2.2.4. Conformance

The conformance section describes the conformance classes provided by the OGC deliverable. This section is used to list out the titles of all conformance classes provided by the deliverable, and provides cross-references to the individual conformance classes as defined in the content body.

```
== Conformance

This OGC Standard provides the following requirements...
```

Figure 44 — Conformance in Metanorma AsciiDoc

9.2.2.5. Normative references

The normative references section describes information resources necessary for the implementation of the document. The bibliographic items are encoded in the Metanorma AsciiDoc bibliography format (see Metanorma for OGC for reference syntax).

```
== Normative references

* [[[OGC_08-131,OGC 08-131r3]]], OGC ModSpec
```

Figure 45 — Normative references in Metanorma AsciiDoc

9.2.2.6. Terms and definitions

The terms and definitions section defines the terms used in the document, which could be defined by the document or imported from other resources.

The terms and definitions section can encode complex concepts and relations, for detailed documentation please refer to the Metanorma website.

```
== Terms and definitions <1>

==== conceptual model <2>
alt:[CM] <3>

model that defines concepts of a universe of discourse <4>

[.source]
<<ISO_19101-1,clause=4.1.5>> <5>

==== logical model

model that implements a {{conceptual model}} at a logical level <6>
```

Key

<1>	Mandatory clause title
<2>	Term for concept
<3>	Alternate term for concept

<4> Definition of concept

<5> Source of concept

<6> Concept mention of a defined term in the same document

Figure 46 — Terms and definitions in Metanorma AsciiDoc

9.2.2.7. Content body

The content body is used to describe the conceptual model and is composed of one or more clauses.

In an OGC MDS document, it is necessary to utilize one or more sections to describe the information model. Typically, the Metanorma LutaML plugin is used to render the conceptual model in XMI format. Information on how to use this automated process is described in Clause 11.3.

```
== Model overview

=== Design requirements

The development of MUDDI has been motivated by a number of specific design
requirements...
```

Figure 47 — Content body in Metanorma AsciiDoc

9.3. Building the document

9.3.1. Single document

The command to build a document is: `metanorma {filename}`.

Example — Example of running the `metanorma compile` command: This command compiles the Metanorma AsciiDoc file `my-ogc-standard.adoc` into an HTML document.

```
$ metanorma my-ogc-standard.adoc
```

9.3.2. Site

Metanorma supports a site build feature that is useful when multiple outputs are expected.

A site manifest needs to be created at `metanorma.yml`, where it internally specifies the component documents of this site. An example is shown in Figure 48.

```
---
metanorma:
  source:
    files:
```

```
      - sources/as21-dggs/20-040r3.adoc
      - sources/as21-dggs/iso-19170-1-is-en-sections.adoc

  collection:
    organization: "OGC"
    name: "OGC TB 17 D144 DGGS XMI model-driven standard"
```

Figure 48 — Example of generating both OGC and ISO flavors using a site manifest

Assuming that the `metanorma.yml` file exists at the current path, the command to generate a site is:

```
$ metanorma site generate
```

Figure 49

The resulting site will be built at `_site` which contains the entry point of `_site/index.html`.

10

SPECIFYING REQUIREMENTS

10 SPECIFYING REQUIREMENTS

10.1. General

This clause describes best practices on how OGC requirements are encoded adhering to the OGC Modular Specification (OGC 08-131r3), also called the "ModSpec", in an OGC deliverable.

OGC ModSpec specifies a requirements model scheme where requirements are expressed through a set of UML models, with description on how these models are to be treated and presented in OGC standards.

According to the OGC Policy Directives, OGC standards that contain requirements must have those requirements conform to OGC 08-131r3.

As OGC utilizes the Metanorma toolchain for publishing its standards, it is necessary for the OGC author to understand how ModSpec instances are encoded in the Metanorma format.

10.2. Background

Metanorma provides a special syntax for the encoding and embedding of requirements compliant to the OGC ModSpec, for the exporting of machine-readable requirements as well as ModSpec-compliant rendering.

Specifically, the following models in the ModSpec are supported in Metanorma:

- Conformance class
- Conformance test
- Requirements class
- Normative statements
    - Requirement
    - Recommendation
    - Permission (not specified in ModSpec but allowed in ISO 19105:2020, see OGC 08-131r3, Clause 4.20)

NOTE 1: The "Conformance suite", "Conformance module", "Requirements module" models are not yet supported in Metanorma. Please contact OGC DocTeam if support is required.

In this document, we refer to “recommendations”, “requirements” and “permissions” collectively using the generic term “requirement”.

NOTE 2: In some instances, the naming of terms that Metanorma uses in general is used in Metanorma markup instead of the nomenclature used in the ModSpec:

- Metanorma uses *target* to refer to what the requirement is about, rather than the more specific language of the ModSpec, to ensure that requirements are represented consistently within Metanorma.
- The different types of requirement expressed by Metanorma for ModSpec are about different things, and the more abstract types of requirement are about other requirements.

10.3. ModSpec models

10.3.1. General

A basic understanding of ModSpec is crucial in order to understand how to encode ModSpec-compliant models.

This clause describes ModSpec models in simplified terms (see OGC 08-131r3, Annex C).

10.3.2. Requirements class

A “Requirements class” consists of multiple “Requirements”.

All “Requirements” within a “Requirements class” are about the same standardization target type.

10.3.3. Requirement

A “Requirement” is a condition to be satisfied by a single standardization target type.

10.3.4. Conformance class

A “Conformance class” consists of multiple “Conformance tests”.

A “Conformance class” is associated with a single corresponding “Requirements class”.

Each “Conformance test” within the “Conformance class” corresponds to a set of “Requirements” within the corresponding “Requirements class”.

10.3.5. Conformance test

A “Conformance test” checks if a set of “Requirements” is met by a single standardization target (an entity).

A “Conformance test” has a many-to-many relation with “Requirements”.

A “Conformance test” is about a single standardization target.

10.3.6. Conformance test suite

A “Test suite” is “a collection of identifiable conformance classes” (see OGC 08-131r3, Clause 6.4)

A “Conformance test suite” contains only “Conformance classes”.

An “Abstract test suite” contains only “Conformance classes” of the “abstract” kind. Such conformance class can only contain Abstract tests.

NOTE 1: ModSpec (OGC 08-131r3, Clause 4.7) defines a conformance test as a “test, abstract or real, of one or more requirements contained within a standard, or set of standards”.

NOTE 2: The OGC Compliance Program has used the term “Executable test suite” for a realized “Abstract test suite” in an implementation. ISO 19105:2020 also uses the term “Executable test suite”.

NOTE 3: A standard document typically does not contain an Executable test suite. Typically, executable tests are not specified in standard documents but are implemented in compliance testing tools instead. This interpretation is also supported by ISO 19105:2020.

10.4. ModSpec instantiation

ModSpec models are defined as classes. In order to create ModSpec models inside an OGC deliverable, it is necessary to “instantiate” them into ModSpec instances.

10.5. Encoding of ModSpec instances

10.5.1. General

A ModSpec instance is encoded in the Metanorma AsciiDoc markup language, via tagged blocks with definition lists, containing other tagged example blocks and open blocks.

NOTE 1: Metanorma also supports the OGC legacy "block attribute" syntax, but it is not described in this document since it is no longer recommended for the flexibility in the newer syntax.

This syntax requires specification of a `[%metadata]` definition list within a ModSpec instance, which provides the necessary information for the specified model. Values given in the definition list syntax can be fully-formatted Metanorma AsciiDoc text.

A ModSpec model instance is encoded with one of these block types:

- `[requirement]` for Requirement
- `[recommendation]` for Recommendation
- `[permission]` for Permission
- `[requirements_class]` for Requirements class
- `[conformance_test]` for Conformance test
- `[conformance_class]` for Conformance class
- `[abstract_test]` for Abstract test

NOTE 2: These ModSpec types are available from [added in Metanorma OGC version v1.4.3]

In addition, if the Metanorma generic `[requirements]` block is used, these values are to be used in the `type` attribute.

The following two encodings are equivalent:

```
[conformance_test]
```

Figure 50

```
[requirement,type=conformance_test]
```

Figure 51

Attributes that can take rich textual input (Metanorma AsciiDoc input), such as `part`, `conditions`, and `guidance`, are components of requirements in Metanorma.

These can be encoded within the definition list, or in the block attributes syntax using the `[.component]` role within the ModSpec instance block, on open blocks or example blocks.

Example 1 — Example of encoding a ModSpec requirement "part" within the definition list

```
[requirement]
====
[%metadata]
identifier:: /req/world/hello
part:: Part A of the requirement.
====
```

Example 2 — Example of encoding a ModSpec requirement "part" in an open block syntax

```
[requirement]
====
[%metadata]
identifier:: /req/world/hello

[.component,class=part]
--
Part A of the requirement.
--
====
```

Example 3 — Example of encoding a ModSpec requirement "part" in an example block syntax

```
[requirement]
=====
[%metadata]
identifier:: /req/world/hello

[.component,class=part]
====
Part A of the requirement.
====
=====
```

The `%metadata` definition list may contain embedded levels [added in Metanorma OGC version v1.4.3]; this is needed specifically for steps embedded within a test method.

If you need to insert a cross-reference to a component, for example referencing a specific part of a requirement elsewhere, you can only use the block attributes sequence (as illustrated above).

```
[requirement]
.Encoding of logical models
====
[%metadata]
identifier:: /spec/waterml/2.0/req/xsd-xml-rules
subject:: system
part:: Metadata models faithful to the original UML model.
description:: Logical models encoded as XSDs should be faithful to the original
UML conceptual models.

test-method::
step::: Step 1
step::: Step 2
step:::: Step 2a
step:::: Step 2b
step::: Step 3
```

```
====
```

Figure 52 — ModSpec requirement with hierarchical test-method steps

When using ModSpec within other documents that, by default, uses another requirements model scheme (such as non-OGC flavors), it is necessary to specify the instance with the `model` attribute.

Example 4 — Encoding a ModSpec instance within a document that uses another requirements model scheme

```
[requirement,model=ogc]
====
[%metadata]
identifier:: /req/iso-nnnnn/considerations

This is an OGC ModSpec requirement within an ISO document.
====
```

10.5.2. Instance attributes

Attributes accepted by a ModSpec instance are as follows:

`identifier`	(mandatory) Identifier of the requirement, such as a URI or a URN. Plain text. This must be unique in the document (as required by ModSpec), and is also used for referencing and cross-linking between ModSpec instances. **NOTE 1:** The `identifier` was previously encoded as `label` until Metanorma OGC version v2.2.0 .
`subject`	(optional) Subject that the model refers to. Plain text.
`obligation`	(optional) Accepted values are one of: `requirement` (default) The instance is a requirement. `recommendation` The instance is a recommendation. `permission` The instance is a permission.
`description`	(optional) The descriptive text for this instance. **NOTE 2:** In a normative statement, the `description` key is treated as a synonym of `statement`, which forms the statement of compliance itself instead of informative, descriptive, text. [added in mn-requirements version v0.2.1].
`target`	(conditional: only for conformance-related models) The “target” that is being tested against, specified with the identifier of the requirement or requirements class. (Replaces `subject` in that context).

	NOTE 3: The `target` is only supported in definition list syntax. [added in Metanorma OGC version v2.2.0] • When in a conformance test (or an abstract test), specify the corresponding identifier of the requirement that is being tested. • When in a conformance class, specify the corresponding identifier of the Requirements class that is being tested.

Differentiated types of ModSpec models allow additional attributes.

10.5.3. Normative statement: requirement, recommendation, permission

Metanorma ModSpec supports the following normative statement types:

- Requirement (`requirement`)
- Recommendation (`recommendation`)
- Permission (`permission`)

The type of normative statement can be specified by using the above values as block types, or by setting the `type` attribute of a block.

It supports the following attributes in addition to base ModSpec attributes:

`statement`	(mandatory) The statement to which compliance applies within this provision. **NOTE 1:** Prior to mn-requirements v0.2.1, the key `description` is used. `description` is now a synonym for `statement` in a provision instance [added in mn-requirements version v0.2.1].
`conditions`	(optional) Conditions on where this requirement applies. Accepts rich text.
`part`	(optional) A requirement can contain multiple parts of sub-requirements. Accepts rich text. Labelled with a capital alphabetic letter. **NOTE 2:** A part is distinct from a step (as appears in Clause 10.5.6): a part is a component of a requirement, which is itself a requirement. A step is a stage in a process of testing a requirement: it only makes sense within a test method.
`guidance`	(optional) Guidance on how to apply the requirement. Used to avoid numbering of notes or examples as part of the overall document. Accepts rich text. Guidance is always rendered last in ModSpec. [added in mn-requirements version v0.1.4]

`inherit`	(optional) A requirement can inherit from one or more requirements (*direct dependency* in ModSpec terms). Accepts identifiers of other requirements: multiple values are semicolon-delimited. Can be repeated in definition list syntax.
`indirect-dependency`	(optional) A requirement can inherit indirectly from one or more Requirements classes, which have a different standardization target from that of the requirement. That Requirements class is used, produced, or associated with the current requirement, but its requirements are not inherited by this requirement. Only supported in definition list syntax. [added in Metanorma OGC version v2.2.1]
`implements`	(optional) A requirement can implement another requirement. Accepts identifiers of other requirements. Can be repeated in definition list syntax [added in mn-requirements version v0.1.9].
`classification`	(optional) Classification of this requirement. The `classification` attribute is marked up as in the rest of Metanorma: `key1=value1;key2=value2...`, where *value* is either a single string, or a comma-delimited list of values.
`requirement`, `permission`, `recommendation`	A requirement, permission, or recommendation contained within a requirement. The value of the element is its identifier. Only supported in definition list syntax.

`conformance-test`, `abstract-test`, `conformance-class`, `requirement-class` `recommendation-class`, `permission-class`:: A requirement, permission, or recommendation of those categories, contained within a requirement. The value of the element is its identifier. Only supported in definition list syntax. [added in mn-requirements version v0.1.6]

NOTE 3: The `conditions`, `part` parameters were not supported in older versions of Metanorma OGC [added in Metanorma OGC version v1.4.2].

NOTE 4: In the default rendering of ModSpec, the `statement` attribute, descriptions are labelled as *Statement* for requirements, recommendations, permissions. They are left as *Description* for all other kinds of ModSpec instances.

Example 1 — OGC CityGML 3.0 sample requirement with two parts (definition list)

```
[requirement]
====
[%metadata]
identifier:: /req/relief/classes
statement:: For each UML class defined or referenced in the Relief Package:
part:: The Implementation Specification SHALL contain an element which
represents the
same concept as that defined for the UML class.
part:: The Implementation Specification SHALL represent associations with the
same
source, target, direction, roles, and multiplicities as those of the UML class.
====
```

This renders as:

REQUIREMENT 1	
Identifier	`/req/relief/classes`
Statement	For each UML class defined or referenced in the Relief Package:
A	The Implementation Specification SHALL contain an element which represents the same concept as that defined for the UML class.
B	The Implementation Specification SHALL represent associations with the same source, target, direction, roles, and multiplicities as those of the UML class.

Example 2 — OGC CityGML 3.0 sample requirement with two parts (block attributes)

```
[requirement,identifier="/req/relief/classes"]
====
For each UML class defined or referenced in the Relief Package:

[.component,class=part]
--
The Implementation Specification SHALL contain an element which represents the
same concept as that defined for the UML class.
--

[.component,class=part]
--
The Implementation Specification SHALL represent associations with the same
source, target, direction, roles, and multiplicities as those of the UML class.
--
====
```

renders as:

Requirement 1	
/req/relief/classes	
For each UML class defined or referenced in the Relief Package:	
A	The Implementation Specification SHALL contain an element which represents the same concept as that defined for the UML class.
B	The Implementation Specification SHALL represent associations with the same source, target, direction, roles, and multiplicities as those of the UML class.

Figure 53

Example 3 — OGC CityGML 3.0 sample requirement with two parts

```
[requirement]
====
[%metadata]
identifier:: /req/core/encoding

All target implementations SHALL conform to the appropriate GroundWaterML2
Logical Model UML defined in Section 8.
```

```
====
```

OGC GroundWaterML 2.0 sample requirement

renders as:

Requirement 3
/req/core/encoding
All target implementations SHALL conform to the appropriate GroundWaterML2 Logical Model UML defined in Section 8.

Figure 54

10.5.4. Requirements class

A “Requirements class” is encoded as a block of `requirements_class` or using `type` equals to `requirements_class`.

A Requirements class is cross-referenced and captioned as a “{Requirement} class {N}” [added in Metanorma OGC version v0.2.11].

NOTE 1: Classes for Recommendations will be captioned as “Recommendations class {N}”, similarly for “Requirements class {N}” and “Permissions class {N}”.

Requirements classes allow the following attributes in addition to the base ModSpec attributes:

Name	(mandatory) Name of the requirements class should be specified as the block caption.
`subject`	(mandatory) The Target Type. Rendered as *Target Type*.
`inherit`	(optional) Dependent requirements classes. See Requirement, recommendation, permission.
`indirect-dependency`	(optional) Indirect dependent requirements classes. See Requirement, recommendation, permission.
`guidance`	(optional) Guidance on Requirements class. See Requirement, recommendation, permission.
Embedded requirements (optional)	Requirements contained in a class are marked up as nested requirements.

Example 1 — Example from OGC CityGML 3.0

```
[requirements_class]
====
[%metadata]
identifier:: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-building
subject:: Implementation Specification
inherit:: /req/req-class-core
inherit:: /req/req-class-construction
====
```

Renders as:

Requirements class 1	
http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-building	
Target type	Implementation Specification
Dependency	/req/req-class-core
Dependency	/req/req-class-construction

Figure 55

NOTE 2: In this example, both block attributes and definition list syntax is used; the `inherit` attribute has two values, which are expressed in the definition list.

A requirements class can contain multiple requirements, specified with embedded requirements.

The contents of these embedded requirements may be specified within the requirements class, or specified outside of the requirements class (referenced using the identifier). If the requirement is specified within a definition list, the definition list value is interpreted as the requirement identifier.

Example 2 — Example from OGC GroundWaterML 2.0

```
[requirements_class]
.GWML2 core logical model
====
[%metadata]
identifier:: http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules[*req/
core*]
obligation:: requirement
subject:: Encoding of logical models
inherit:: urn:iso:dis:iso:19156:clause:7.2.2
inherit:: urn:iso:dis:iso:19156:clause:8
inherit:: http://www.opengis.net/doc/IS/GML/3.2/clause/2.4
inherit:: O&M Abstract model, OGC 10-004r3, clause D.3.4
inherit:: http://www.opengis.net/spec/SWE/2.0/req/core/core-concepts-used
requirement:: /req/core/encoding
requirement:: /req/core/quantities-uom
====
```

renders as:

Requirements class 1 GWML2 core logical model	
req/core	
Obligation	Requirement
Target Type	Encoding of logical models

Dependency	urn:iso:dis:iso:19156:clause:7.2.2
Dependency	urn:iso:dis:iso:19156:clause:8
Dependency	http://www.opengis.net/doc/IS/GML/3.2/clause/2.4
Dependency	O&M Abstract model, OGC 10-004r3, clause D.3.4
Dependency	http://www.opengis.net/spec/SWE/2.0/req/core/core-concepts-used
Requirement	/req/core/encoding
Requirement	/req/core/quantities-uom

Embedded requirements (such as are found within Requirements classes) will automatically insert cross-references to the non-embedded requirements with the same identifier [added in Metanorma OGC version v1.0.8].

Example 3 — Example of specifying embedded requirements within a ModSpec instance

```
[requirements_class,identifier="/req/conceptual"]
.GWML2 core logical model
====

[requirement,identifier="/req/core/encoding"]
======
======

====

[requirement,identifier="/req/core/encoding"]
====
Encoding requirement
====
```

renders as:

Requirements class 3: GWML2 core logical model /req/conceptual	
Requirement 1	/req/core/encoding

Requirement 1 /req/core/encoding
Encoding requirement

10.5.5. Conformance class

Specified by setting the block as `conformance_class` or by using `type` as `conformance_class`.

A Conformance class is cross-referenced and captioned as "Conformance class {N}", and is otherwise rendered identically to a "Requirements class" [added in Metanorma OGC version v1.0.4].

Conformance classes support the following attributes in addition to base ModSpec attributes:

`target`	(mandatory) Associated Requirements class. Populated with the identifier of the Requirements class. Rendered as *Requirements Class*.
`inherit`	(optional) Dependencies of the conformance class. Accepts multiple values, which are the identifiers of other requirements. See Requirement, recommendation, permission.
`indirect-dependency`	(optional) Indirect dependent requirements classes. See Requirement, recommendation, permission.

Conformance classes also feature:

Name	(optional) Specified as the block caption.
Nesting	(optional) Conformance tests contained in a conformance class are encoded as conformance tests within the conformance class block, marked as `conformance-test`. See Requirements class.

NOTE: Conformance classes do not have a Target Type (as specified in ModSpec). If one must be encoded, it should be encoded as a classification key-value pair.

Example — Example of encoding a conformance class

```
[conformance_class]
====
[%metadata]
identifier:: http://www.opengis.net/spec/ogcapi-features-2/1.0/conf/crs
target:: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-building
indirect-dependency:: http://www.opengis.net/doc/IS/ogcapi-features-1/1.0#ats_
core
classification:: Target Type:Web API
====
```

renders as:

CONFORMANCE CLASS 1	
http://www.opengis.net/spec/ogcapi-features-2/1.0/conf/crs	
Requirements Class	*Requirements Class 'Coordinate Reference Systems by Reference'*

CONFORMANCE CLASS 1	
Dependency	http://www.opengis.net/doc/IS/ogcapi-features-1/1.0#ats_core
Target Type	Web API

10.5.6. Conformance test and Abstract test

A “Conformance test” can be “concrete” or “abstract” depending on the type of conformance test suite (see OGC 08-131r3, Clause 6.4).

NOTE 1: A implementation of a test in executable form is called an “executable test”. A standard typically does not include executable tests.

The OGC author should identify whether a standard requires an “Abstract test suite” or a “Conformance test suite” in order to decide the encoding of “Conformance tests” versus “Abstract tests”.

- A conformance test is specified by creating a `conformance_test` block or using `type` as `conformance_test`. It is cross-referenced as “Conformance test {N}”.
- An abstract test is specified by creating an `abstract_test` block or using `type` as `abstract_test`, or `conformance_test` together with `abstract=true`. It is cross-referenced as “Abstract test {N}” [added in Metanorma OGC version v1.0.4].

Conformance tests support the following attributes and components in addition to base ModSpec attributes:

`target`	The associated requirement. Populated with the identifier of the requirement. Multiple semicolon-delimited values may be provided. Rendered as *Requirement*.	
`inherit`	(optional) Dependencies. Accepts multiple values, which are the identifiers of other requirements. See Requirement, recommendation, permission. • `indirect-dependency` (optional). Indirect dependent requirements classes. See Requirement, recommendation, permission.	
Components	(optional) Components of the conformance test. Accepts rich text. [added in Metanorma OGC version v1.4.0]. Allows the following classes:	
	`test-purpose`	(optional) Purpose of the test. Rich text. Presented as *Test Purpose* [added in Metanorma OGC version v1.4.2]
	`test-method`	(optional) Method of the test. Rich text. Presented as *Test Method* [added in Metanorma OGC version v1.4.2]

	`step`	(optional) Step of the test method. Is expected to be embedded within `test-method`, and may contain substeps of its own. Rich text. Presented as a numbered list. added in Metanorma OGC version v1.4.2]. Steps can be nested, the nested list order is: *arabic*, then *alphabetic*, then *roman*.
	`test-method-type`	(optional) Method of the test. Rich text. Presented as *Test Method Type* [added in Metanorma OGC version v1.4.3]
	`reference`	(optional) Purpose of the test. Rich text. Presented as *Reference*.
Test type	The test type of a Conformance test is encoded as a `classification` key-value pair.	

Conformance tests also feature:

- Name (optional). Specified as the requirement's block caption.

NOTE 2: Conformance Tests are excluded from the "Table of Requirements" in Word output [added in Metanorma OGC version v0.2.10].

Example 1 — Example of Abstract test from CityGML 3.0

```
[abstract_test]
====
[%metadata]
identifier:: /conf/core/classes

target:: /req/core/classes

test-purpose:: To validate that the Implementation Specification correctly
implements the UML Classes defined in the Conceptual Model.

test-method-type:: Manual Inspection

description:: For each UML class defined or referenced in the Core Package:

part:: Validate that the Implementation Specification contains a data element
which represents the same concept as that defined for the UML class.

part:: Validate that the data element has the same relationships with other
elements as those defined for the UML class. Validate that those relationships
have the same source, target, direction, roles, and multiplicities as those
documented in the Conceptual Model.
====
```

renders as:

Abstract test 1	
/ats/core/classes	
Requirement	/req/core/classes
Test purpose	To validate that the Implementation Specification correctly implements the UML Classes defined in the Conceptual Model.
Test-method-type	Manual Inspection
For each UML class defined or referenced in the Core Package:	
A	Validate that the Implementation Specification contains a data element which represents the same concept as that defined for the UML class.
B	Validate that the data element has the same relationships with other elements as those defined for the UML class. Validate that those relationships have the same source, target, direction, roles, and multiplicities as those documented in the Conceptual Model.

Figure 56

Example 2 — Example of Abstract test from DGGS

```
[abstract_test]
====
[%metadata]
identifier:: /conf/crs/crs-uri
target:: /req/crs/crs-uri
target:: /req/crs/fc-md-crs-list-A
target:: /req/crs/fc-md-storageCrs
target:: /req/crs/fc-md-crs-list-global
classification:: Test Type:Basic
test-purpose:: Verify that each CRS identifier is a valid value
test-method::
+
--
For each string value in a `crs` or `storageCrs` property in the collections
and collection objects,
validate that the string conforms to the generic URI syntax as specified by
https://tools.ietf.org/html/rfc3986#section-3[RFC 3986, section 3].

. For http-URIs (starting with `http:`) validate that the string conforms to
the syntax specified by RFC 7230, section 2.7.1.

. For https-URIs (starting with `https:`) validate that the string conforms to
the syntax specified by RFC 7230, section 2.7.2.
--
reference:: <<ogc_07_147r2,clause=15.2.2>>
====
```

renders as:

ABSTRACT TEST 1
/conf/crs/crs-uri

ABSTRACT TEST 1	
Requirement	*/req/crs/crs-uri*, */req/crs/fc-md-crs-list A*, */req/crs/fc-md-storageCrs*, */req/crs/fc-md-crs-list-global*
Test Purpose	Verify that each CRS identifier is a valid value
Test Method	For each string value in a `crs` or `storageCrs` property in the collections and collection objects, validate that the string conforms to the generic URI syntax as specified by RFC 3986, section 3. 1. For http-URIs (starting with `http:`) validate that the string conforms to the syntax specified by RFC 7230, section 2.7.1. 2. For https-URIs (starting with `https:`) validate that the string conforms to the syntax specified by RFC 7230, section 2.7.2.
Reference	OGC-07-147r2: cl. 15.2.2
Test Type	Basic

10.6. Cross-referencing ModSpec instances

10.6.1. General

Similar to when specifying attributes for ModSpec instances, it is preferred to refer to other instances using identifiers, rather than the numbered labels allocated by default.

Example: In OGC, it is preferred to show the identifier of a ModSpec instance in a cross-reference, like `http://www.example.com/req/crs/crs-uri` instead of *Requirements class 6*.

10.6.2. Referencing using predefined anchors

This can be extended to cross-references. If the anchor of the requirement is known, a normal cross-reference can be marked up, as shown below.

Example — Cross-reference to a ModSpec instance using a predefined anchor

```
<<id1,http://www.example.com/req/crs/crs-uri>>
```

Renders (assuming that this is the 10th Requirement):

Requirement 10

10.6.3. Referencing using instance identifiers

However, not all ModSpec instances are assigned predefined anchors, especially when using model-based generation. It also precludes automated manipulation of the identifier base path.

For that reason, Modspec in Metanorma supports anchor aliasing: the identifier of the requirement can be used in cross-references as an alias of the anchor.

Metanorma will automatically map the anchor it allocates to requirements to identifiers, to that end: users do not need to supply the anchor alias mappings manually.

So for a requirement such as:

```
[[id1]]
[requirement]
====
identifier:: http://www.example.com/req/crs/crs-uri
====
```

Figure 57

It is possible to reference a ModSpec instance using its identifier instead of the anchor, as follows.

Example 1 — Cross-reference to a ModSpec instance using its identifier, displaying the instance's name

```
xref:http://www.example.com/req/crs/crs-uri[]
```

Renders (assuming that this is the 10th Requirement):

Requirement 10

Metanorma treats them as fully equivalent, and will render them in the same way, as a numbered label (*Requirements class 6*).

NOTE: As a limitation of syntax, URIs cannot be processed correctly within `\<< >>`. The `xref:…[]` command needs to be used instead.

To make the cross-reference render the identifier value of the instance itself, while still hyperlinking to the correct identifier, you can specify `style=id%` as the cross-reference text, as follows.

Example 2 — Cross-reference to a ModSpec instance using its identifier, displaying the instance's identifier

```
xref:http://www.example.com/req/crs/crs-uri[style=id%]
```

Renders as:

http://www.example.com/req/crs/crs-uri

This will also highlight the URI text as subject to truncation, with reference to identifier bases.

10.6.4. Identifier base pattern

NOTE 1: This functionality is first implemented in [added in mn-requirements version v0.2.1].

A ModSpec instance can be cross-referenced from other parts of the document, with the reference text used to identify the ModSpec instance named either according to its:

- instance label (e.g., “Requirement 3”); or
- identifier (e.g., `http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules`).

ModSpec instances need to be assigned unique identifiers, which are typically either URIs, URNs or URLs.

These identifier types utilize a hierarchical pattern. If two identifiers share a common prefix, it means that the two identifiers can be grouped semantically at some level.

In well-structured standards (in OGC and others), ModSpec instances often share a common identifier prefix. For example, a defined, document-wide identifier prefix is used as the “base” for all ModSpec identifiers.

Example 1 — Document-wide identifier prefix with ModSpec instances using that prefix: OGC WaterML 2.0 applies a document identifier prefix:

- document identifier prefix: `http://www.opengis.net/spec/waterml/2.0`
- sample of a ModSpec instance identifier in the document: `http://www.opengis.net/spec/waterml/2.0/req/xsd-xml-rules`

When cross-referencing a ModSpec instance using its identifier, the references can be lengthy to read.

If a document-wide identifier “base prefix” is defined, Metanorma will omit the base prefix in the rendering of ModSpec instances when using the identifier as reference text.

There are the following ways of specifying an identifier base prefix:

Document-wide	The document attribute `:modspec-identifier-base:` is used to specify the identifier base prefix for the entire document.
ModSpec class instance	An identifier base prefix can be defined inside a ModSpec class instance (e.g., Requirements class), using the definition list tag `identifier-base`.
ModSpec instance	An identifier base prefix can be defined inside a ModSpec instance (e.g., Requirement), using the definition list tag `identifier-base`.

The behavior is specified as follows:

- If an identifier base prefix is specified document-wide:

    - When a ModSpec instance or class instance is cross-referenced using its identifier, the identifier base prefix will be removed from the identifier in the reference text.

- If an identifier base prefix is specified on a ModSpec class instance (e.g., Requirements class):
    - This identifier base prefix overrides any value specified in `:modspec-identifier-base:`, if any;
    - The identifier base prefix specified will apply to all its ModSpec instances (e.g., Requirements in the Requirements class) unless overridden; and
    - When a ModSpec class instance is cross-referenced using its identifier, the identifier base prefix will be removed from the identifier in the reference text.

- If an identifier base prefix is specified on a ModSpec instance (e.g., Requirement):
    - The identifier base prefix specified on the instance overrides all higher level identifier base prefixes;
    - The identifier base prefix specified on the instance's class (e.g., Requirements class) overrides any value specified in `:modspec-identifier-base:`, if any; and
    - When the instance is cross-referenced using its identifier, the identifier base prefix will be removed from the identifier in the reference text.

NOTE 2: An identifier base specified on a requirement applies to all ModSpec requirement cross-references rendered within that requirement. The identifier base truncation is applied to cross-references rendered as just the identifier (`style=id%`), but it is also applied to the identifiers incorporated inside of normal cross-references, and to the identifier labels of requirements.

Example 2 — Setting a document-wide identifier base prefix

```
:modspec-identifier-base: http://www.example.com

Refer to
xref:http://www.example.com/req/class1[] and
xref:http://www.example.com/req/class1/req1[style=id%].

[requirements_class]
```

identifier	http://www.example.com/req/class1
requirement	http://www.example.com/req/class1/req1
description	Some description.

Example 3:

identifier	http://www.example.com/req/class1/req1
statement	A requirement.

Example 4

```
Renders as:

____

Refer to
/req/class1 and /req/class1/req1.

|===
2+| Requirements class 1

h| Identifier          | `/req/class1/`
h| Normative statement | Requirement 1: `/req/class1/req1`
h| Description         | Some description.
|===

|===
2+| Requirement 1

h| Identifier  | `/req/class1/req1`
h| Included in | Requirements class 1: `/req/class1`
h| Statement   | A requirement.
|===
____
```

Example 5 — Setting a identifier base prefix at a class instance

```
[requirement,type=requirements_class]
```

identifier	http://www.example.com/req/class1
identifier-base	http://www.example.com/req
requirement	http://www.example.com/req/class1/req1
description	Some description.

Example 6:

identifier	http://www.example.com/req/class1/req1
statement	A requirement.

Example 7

```
Renders as:

____
|===
2+| Requirements class 1

h| Identifier          | `/class1/`
h| Normative statement | Requirement 1: `/class1/req1`
h| Description         | Some description.
|===

|===
2+| Requirement 1
```

```
h| Identifier  | `/class1/req1`
h| Included in | Requirements class 1: `/class1`
h| Statement   | A requirement.
|===
____
```

Example 8 — Setting identifier base prefixes for document-wide and at the class instance level

```
:modspec-identifier-base: http://www.example.com

[requirement-class]
----
identifier:: http://www.example.com/req/class1
identifier-base:: http://www.example.com/req
requirement:: http://www.example.com/req/class1/req1
----

[requirement-class]
----
identifier:: http://www.example.com/req/class2
requirement:: http://www.example.com/req/class2/req2
----

[requirement]
----
identifier:: http://www.example.com/req/class1/req1
statement:: See also xref:http://www.example.com/req/class2/req2[style=id%].
----

[requirement]
----
identifier:: http://www.example.com/req/class2/req2
statement:: See also xref:http://www.example.com/req/class1/req1[].
----
```

Renders as:

REQUIREMENTS CLASS 1	
IDENTIFIER	`/class1`
NORMATIVE STATEMENT	Requirement 1: `/class1/req1`

REQUIREMENTS CLASS 2	
IDENTIFIER	`/req/class2`
NORMATIVE STATEMENT	Requirement 2: `/req/class2/req2`

REQUIREMENT 1	
IDENTIFIER	`/class1/req1`
INCLUDED IN	Requirements class 1: `/class1`
STATEMENT	See also /class2/req2

REQUIREMENT 2	
IDENTIFIER	`/req/class2/req2`
INCLUDED IN	Requirements class 2: `/req/class2`
STATEMENT	See also Requirement 1: `/req/class1/req1`

10.7. Rendering of ModSpec instances

ModSpec instances are rendered in a table format.

NOTE 1: This rendering method is consistent with prior OGC ModSpec practice.

- For HTML rendering, the CSS class of the ModSpec specification table is the `type` attribute of the requirement.

  The following types are recognized:

  - No value for Requirements
  - `conformance_test` for Conformance tests
  - `abstract_test` for Abstract tests
  - `requirements_class` for Requirements classes
  - `conformance_class` for Conformance classes

  NOTE 2: The default CSS class currently assigned for HTML rendering is `recommend`.

- The heading of the table (spanning two columns) is its name (the role or style of the requirement, e.g., `[permission]` or `[.permission]`), optionally followed by its title (the caption of the requirement, e.g., `.Title`).
- The title of the table (spanning two columns) is its `identifier` attribute.

- The initial rows of the body of the table give metadata about the requirement and includes the following.
    - The `obligation` attribute of the requirement, if given: *Obligation* followed by the attribute value.
    - The `subject` attribute of the requirement, if given: *Subject*, followed by the attribute. The subject attribute can be marked up as a cross-reference to another requirement given in the same document. If there are multiple values of the subject, they are semicolon delimited [added in https://github.com/metanorma/metanorma-standoc/releases/tag/v1.10.4].
    - The `inherit` attribute of the requirement, if given: *Dependency* followed by the attribute value. If there are multiple values of the attribute, they are semicolon delimited.
    - The `indirect-dependency` attribute of the requirement, if given: *Indirect Dependency* followed by the attribute value. If there are multiple values of the attribute, they are semicolon delimited.
    - The `classification` attributes of the requirement, if given: the classification tag (in capitals), followed by the classification value.

- The remaining rows of the requirement are the remaining components of the requirement, encoded as table rows instead of as a definition table (as they are by default in Metanorma).
    - These include the explicit `component` components of the requirement [added in Metanorma OGC version v1.4.0], which capture internal components of the requirement defined in ModSpec.

      These are divided into two categories.
        - Components with a `class` attribute other than `part` are extracted in order, with the class name normalised (title case), followed by the component contents. So a component with a `class` attribute of `conditions` will be rendered as *Conditions* followed by the component contents. In the foregoing, we have seen components defined in ModSpec: `test-purpose`, `test-method`, `test-method-type`, `conditions`, `reference`. However the block attribute syntax allows open-ended component names.
        - Components with the `class` attribute `part` are extracted and presented in order: each Part is rendered as an incrementing capital letter (*A*, *B*, *C* and so on), followed by the component contents. Any cross-references to part components will automatically be labelled with the identifier of their parent requirement, followed by their ordinal letter.

    - Components can include descriptive text (`description`), which is interleaved with other components.

- Components can include open blocks marked with role attributes. That includes the legacy Metanorma components:
  - `[.specification]`
  - `[.measurement-target]`
  - `[.verification]`
  - `[.import]`

11

RENDER UML MODELS

11 RENDER UML MODELS

11.1. Render UML models with LutaML

OGC uses the Metanorma toolchain for publishing standards. The steps involved in transforming UML models into an MDS can be as simple as the conversion from UML models into Metanorma syntax.

This clause describes in detail how this conversion step is performed.

OGC (through Testbed-17) has developed an automated workflow that provides a default UML rendering template set to render each UML class and package in the same way. This workflow uses the LutaML plugin to render the UML model's contents into document elements, called the `[lutaml_uml_datamodel_description]` block.

The `[lutaml_uml_datamodel_description]` block is used to iterate through a sequence of UML packages, rendering each in a consistent way. The rendering template for each type of UML element is predefined. Users do not have to supply their own template text unless overriding is needed.

NOTE: LutaML uses Liquid as its templating language.

11.2. Exporting an MDS-readable model from EA

In order to make its information accessible to the MDA process, the UML models and associated information needs to be exported into an interoperable format.

Enterprise Architect version 16 onwards uses a proprietary binary format called `qea`, which is not readable outside of the application itself.

The interoperable format used in the OGC MDS process is the OMG UML format exported as OMG XMI (XML Model Interchange) (OMG XMI 2.5.1) format, as an XML file with the extension of `xmi`.

To export a UML Package (top-level package or one of the packages), first select the UML Package to be exported, then click on "Publish As..." as shown in Figure 58.

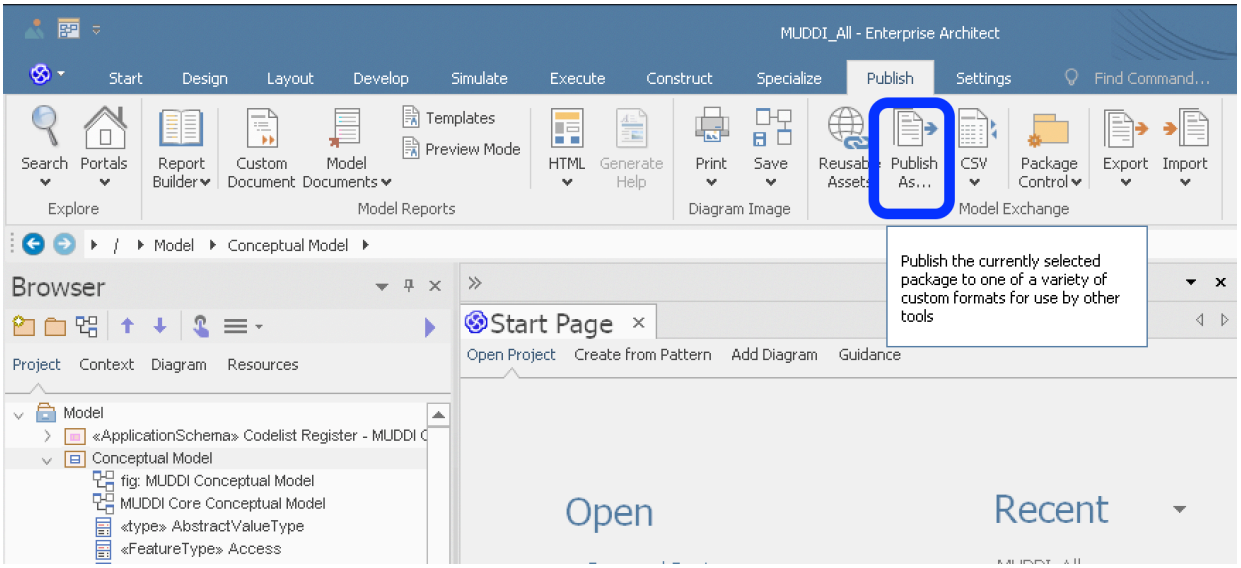


Figure 58 — Location of the "Publish As..." button

Clicking on the “Publish As...” button opens a dialog box with the options shown in Figure 59.

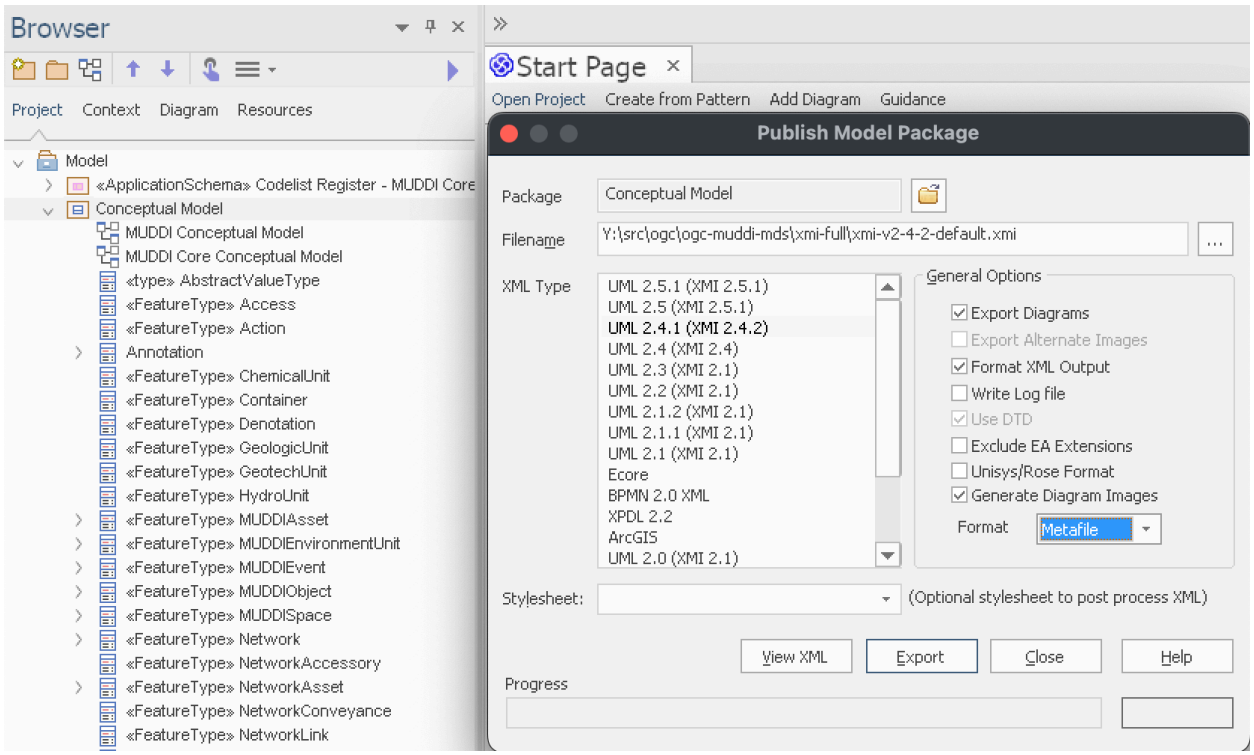


Figure 59 — Generation options for an XMI that works with Metanorma

The user will need to export the file with the following configuration set:

- Filename change the file extension to use `.xmi` in the “...” dialog box
- XML Type set to “UML 2.4.1 (XMI 2.4.2)”

- Check the following boxes in “General Options”:
  - Export Diagrams
  - Format XML Output
  - Generate Diagram Images, set Format to “SVG”
- Click on “Export”

NOTE: The Format “SVG” option is supported from EA version 16.1. Prior to 16.1, EMF was the only vector image format.

When these steps are followed the exported XMI will be at the path specified, ready to serve as input for the MDS process.

The resulting output will be placed in the selected directory as seen in Example 1. Note that the UML diagrams will be exported under a new directory called `Images/` under the selected directory.

Example 1 — Example of EA-exported XMI with SVG images

```
working-directory/
+- xmi-v2-4-2-default.xmi
+- UML_EA.dtd
+- Images/
   +- EAID_40625194_4483_46b2_80CF_2756F08865D8.svg
   +- EAID_76FDCDFB_19E5_47b6_9D21_E6450814059F.svg
   +- EAID_9499129E_BD74_4df2_9AC5_680582E4CD47.svg
```

For typical UML diagrams, the “SVG” format exports into `*.svg` files, and work best since they are vector images. SVG images allow for perfect scaling in PDF output and in HTML web browsers.

However, the EA SVG export functionality can occasionally fail to produce accurate results, especially for complex UML diagrams that involve custom relationships and lines.

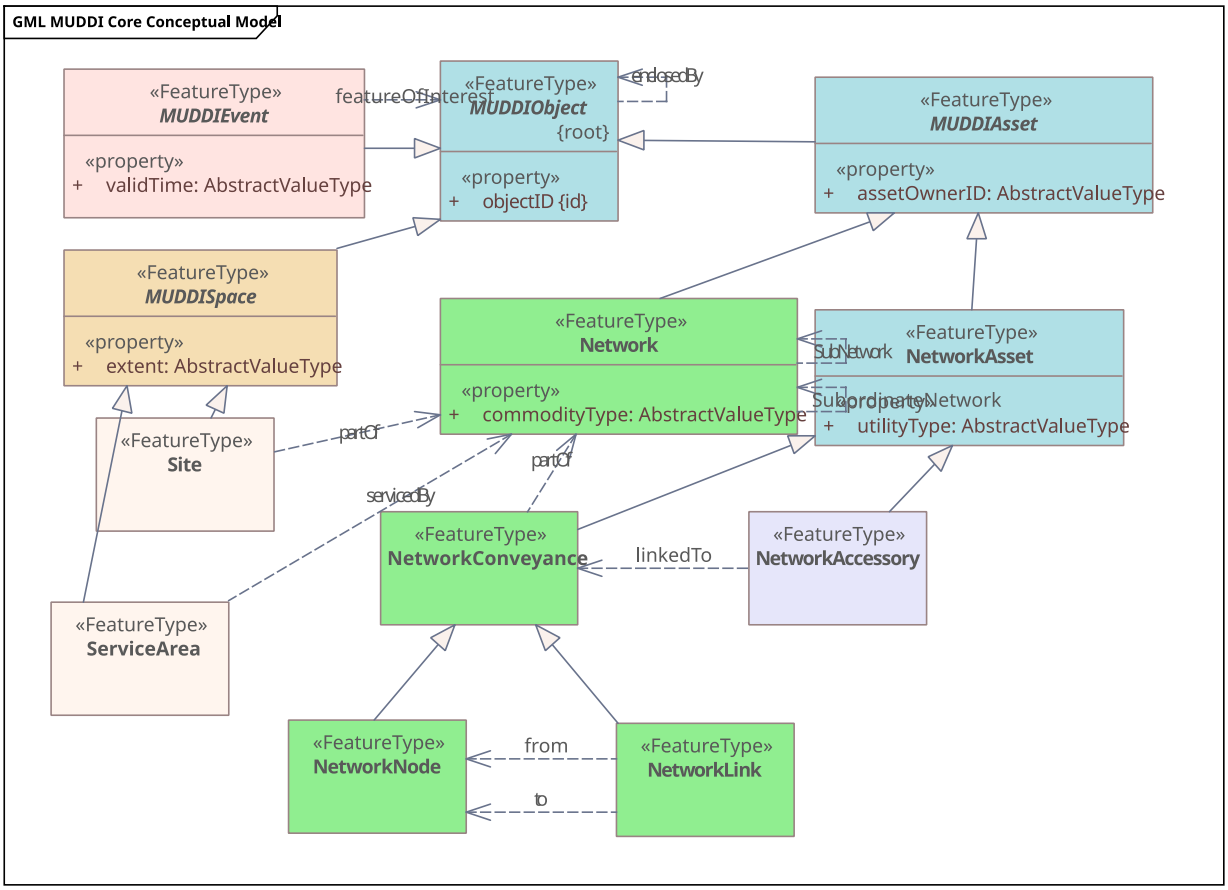


Figure 60-1 — EA-generated SVG file containing inaccurate layout

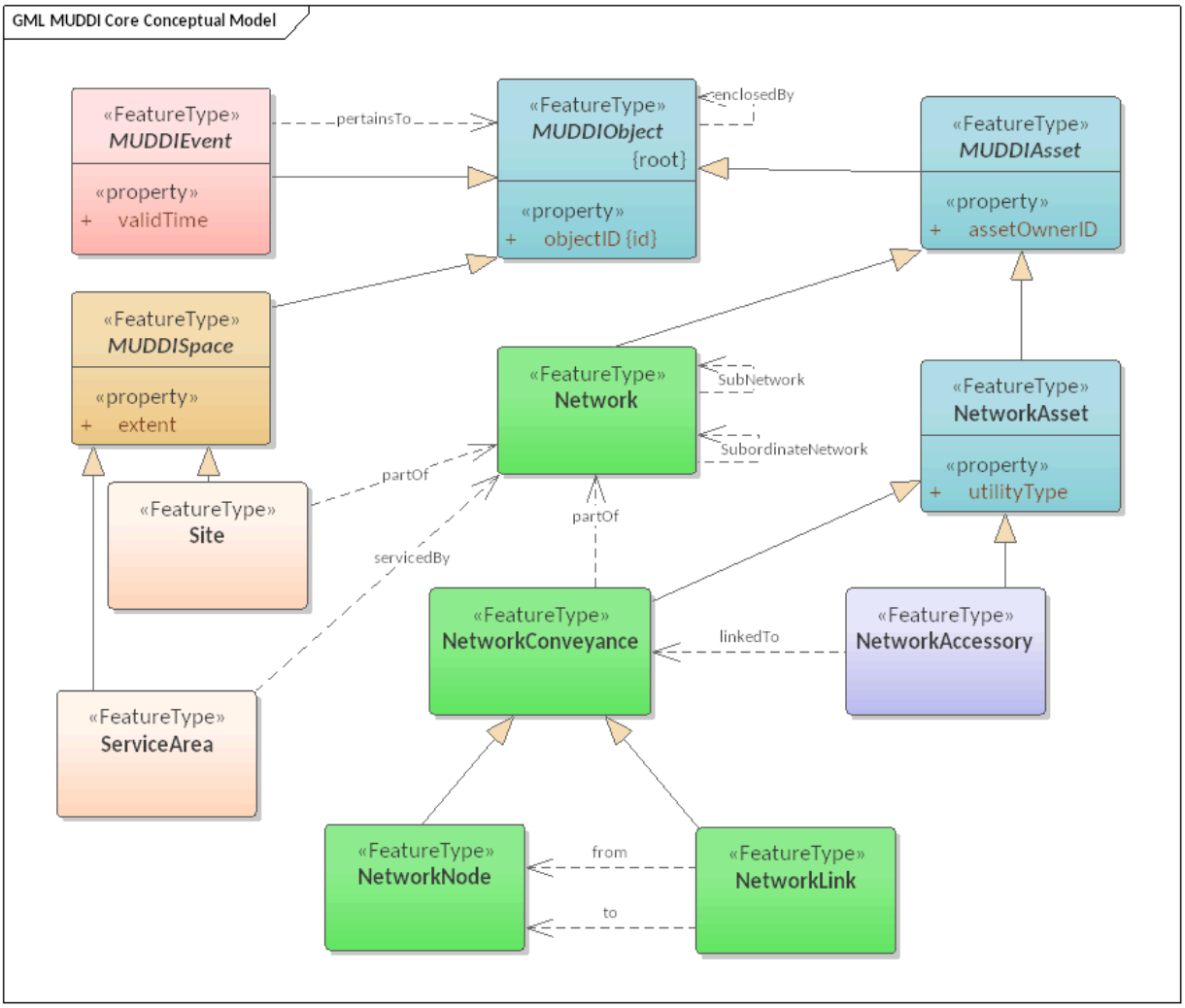


Figure 60-2 — EA-generated PNG file with correct layout

Figure 60 — Example of failed EA exported SVG

In this case, the following additional steps will also export PNG images in the same directory:

- Filename change the file extension to use `.xmi` in the "..." dialog box
- XML Type set to "UML 2.4.1 (XMI 2.4.2)"
- Check the following boxes in "General Options":
  - Export Diagrams
  - Format XML Output
  - Generate Diagram Images, set Format to "PNG"
- Click on "Export"

If one specifies the same location for exporting PNG images, they will be placed alongside the previously generated SVG images as shown in Example 2.

Example 2 — Example of EA-exported XMI with mixed SVG and PNG images

```
working-directory/
+- xmi-v2-4-2-default.xmi
+- UML_EA.dtd
+- Images/
   +- EAID_40625194_4483_46b2_80CF_2756F08865D8.svg
   +- EAID_40625194_4483_46b2_80CF_2756F08865D8.png
   +- EAID_76FDCDFB_19E5_47b6_9D21_E6450814059F.svg
   +- EAID_76FDCDFB_19E5_47b6_9D21_E6450814059F.png
   +- EAID_9499129E_BD74_4df2_9AC5_680582E4CD47.svg
   +- EAID_9499129E_BD74_4df2_9AC5_680582E4CD47.png
```

11.3. Basic usage

Basic usage of the `[lutaml_uml_datamodel_description]` command is given in Figure 61.

```
[lutaml_uml_datamodel_description,path/to/example.xmi]
--
--
```

Figure 61 — Basic usage of the `lutaml_uml_datamodel_description` block

`lutaml_uml_datamodel_description` declares the type of this block; `path/to/example.xmi` is the path to the OMG XMI file.

This command generates a Metanorma representation of the UML elements contained in the XMI file `path/to/example.xmi`.

By default, this block will iterate through the entire XMI file:

- Including all diagrams as figures in the MDS; and
- Rendering all UML elements hierarchically in the order of Package, Classes, Attributes, Associations, etc.

11.4. Configuration file

11.4.1. General

The behavior of the `lutaml_uml_datamodel_description` can be customized through providing a configuration file in YAML, as shown in Figure 62.

```
[lutaml_uml_datamodel_description,path/to/example.xmi,config.yaml]
--
--
```

Figure 62 — Configuring behavior of the `lutaml_uml_datamodel_description` block

`config.yaml` is the path to a YAML config file for the `lutaml_uml_datamodel_description` block.

The `config.yaml` parameter is optional. The nominated YAML file specifies which packages to process in the command, in which order; rendering style instructions; and the location of the root package.

The syntax of the YAML file is described in Figure 63.

```
---
packages: <1>
  # includes these packages
  - "Package *"
  - two*
  - three
  # skips these packages
  - skip: four
render_style: data_dictionary <2>
section_depth: 2 <3>
package_root_level: 2 <4>
```

Key

<1>	The `packages` key.
<2>	The `render_style` key.
<3>	The `section_depth` key.
<4>	The `package_root_level` key.

Figure 63 — YAML configuration for `lutaml_uml_datamodel_description` command

All keys in the configuration files are optional.

11.4.2. Package inclusion

The `packages` key accepts an array of package name specifications that describes which packages to be included or excluded. The filter execution order is in the sequence of specification.

Specifically, any package that matches the given pattern (supporting regular expression matches) will be included in output.

Example 1: The regular expression "three" will only match the package name "three", which will be included in the rendered output.

Example 2: The regular expression `Package *` will match "Package 1", "Package X" and "Package This-And-That".

To exclude packages, a syntax of `skip: {name}` is used for the package name specification. If a package was included in one of the matches, a skip rule that matches will cause that package to be skipped.

Example 3: The specification "skip: four" will specifically skip the package named "four" even if it was included in one of the matches prior to the skip rule.

11.4.3. Rendering style

11.4.3.1. General

The `render_style` value indicates the automated generation style to be used.

The generation style affects:

- the clause hierarchical structure; and
- the content rendered from the generated UML models.

There are 3 types of UML rendering styles:

- `default`: the default manner to render UML packages and classes in an OGC deliverable;
- `entity_list`: the entity list style provides a high level summary of all elements in a package; and
- `data_dictionary`: the data dictionary style provides detailed definitions to describe elements in a package.

In practice, the entity list and the data dictionary styles are commonly meant to be used together in a single document. This combination should only used when there is an unexcusable need to deviate from the default style, such as for:

- highly-modularized documents, where models are packaged in multiple modules;
- backwards compatibility for deliverables that have previously adopted the entity list + data dictionary structure; and
- models with a deep hierarchy, which the default style would lead to very deep clause hierarchies.

Example 1: The default style is used for OGC 20-040r3.

Example 2: The entity list + data dictionary style is used for OGC 20-010.

11.4.3.2. Default style

The default style is considered the style to use for new MDS documents as it provides an OGC accepted order and rendering of UML components.

In the default style, the following steps are taken:

1. For every UML package ("package-name"):
    a) Render an overview subclause for the package, titled "{package-name} overview", with the following content:
        i) If this package contains subpackages, render the following:
            - "The {package-name} package is organized into {sub-package-count} packages:"
            - Each sub-package is then listed out
        ii) Figures included in the top-most level of the package are rendered.
    b) For every sub-packages, recurse as per step 1.
    c) Render defining tables for every element in this package (in the order of Class / Interface / Union / DataType) according to this list of information:
        - Name
        - Definition
        - Stereotype
        - Inheritance from (optional)

- Generalization of (optional)
- Abstract
- Associations: Association with; Obligation; Maximum occurrence; Provides
- Public attributes: Name; Definition; Derived; Obligation; Maximum occurrence; Data type
- Constraints

An example of the `default` style is shown in Figure 64.

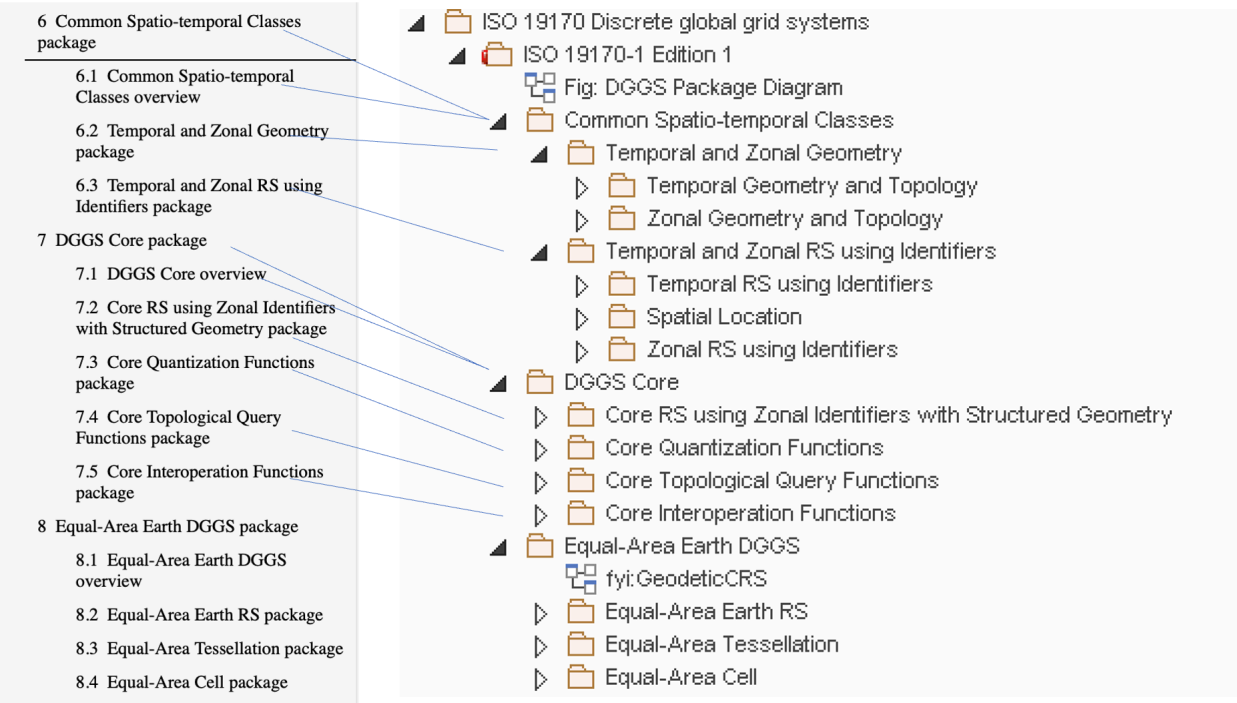


Figure 64 — Rendering style `default` used in OGC 20-040r3 (ISO 19170)

11.4.3.3. Entity list style

The entity list style provides an overview listing of all UML components within a UML package. It provides a high-level overview of the UML package and is meant to be used together with the data dictionary style.

This style was originally developed from OGC 20-010 and is only recommended for MDS experts to tailor the MDS experience.

An example of the `entity_list` style is shown in Figure 65 and Figure 66.

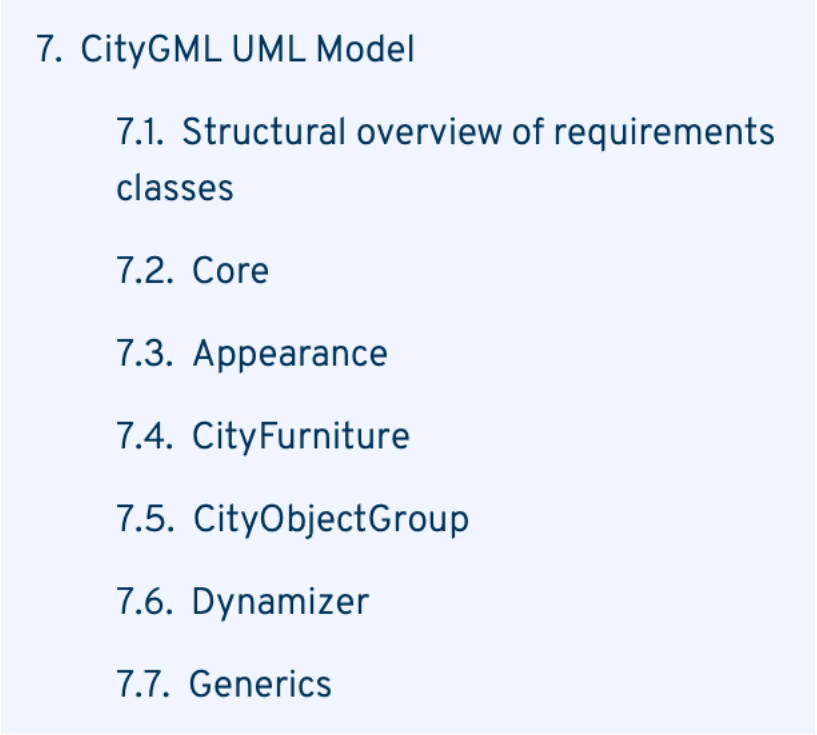


Figure 65 — Rendering style `entity_list` table of contents used in OGC 20-010

Table 5 — Space Classes used in Core

CLASS	DESCRIPTION
AbstractLogicalSpace «FeatureType»	AbstractLogicalSpace is the abstract superclass for all types of logical spaces. Logical space refers to spaces that are not bounded by physical surfaces but are defined according to thematic considerations.
AbstractOccupiedSpace «FeatureType»	AbstractOccupiedSpace is the abstract superclass for all types of physically occupied spaces. Occupied space refers to spaces that are partially or entirely filled with matter.
AbstractPhysicalSpace «FeatureType»	AbstractPhysicalSpace is the abstract superclass for all types of physical spaces. Physical space refers to spaces that are fully or partially bounded by physical objects.
AbstractSpace «Feature Type»	AbstractSpace is the abstract superclass for all types of spaces. A space is an entity of volumetric extent in the real world.
AbstractSpaceBoundary «FeatureType»	AbstractSpaceBoundary is the abstract superclass for all types of space boundaries. A space boundary is an entity with areal extent in the real world. Space boundaries are objects that bound a Space. They also realize the contact between adjacent spaces.
AbstractThematicSurface «FeatureType»	AbstractThematicSurface is the abstract superclass for all types of thematic surfaces.

Figure 66 — Rendering style `entity_list` body contents used in OGC 20-010

11.4.3.4. Data dictionary style

The data dictionary style provides a detailed listing of all UML components within a UML package. It provides a detailed-level inspection of the UML package and is meant to be used together with the entity list style.

This style was originally developed from OGC 20-010 and is only recommended for MDS experts to tailor the MDS experience.

An example of the `data_dictionary` style is shown in Figure 67, Figure 68 and Figure 69.

Figure 67 — Rendering style `data_dictionary` table of contents used in OGC 20-010

8.2. Core

Table 103 — Metadata of Core (ApplicationSchema)

DESCRIPTION:	The Core module defines the basic components of the CityGML conceptual model. This includes abstract base classes that define the core properties of more specialized thematic classes defined in other modules as well as concrete classes that are common to other modules, for example basic data types.
PARENT PACKAGE:	CityGML
STEREOTYPE:	«ApplicationSchema»

Figure 68 — Rendering style `data_dictionary` body content part 1 used in OGC 20-010

8.2.1. Classes

8.2.1.1. AbstractAppearance

Table 104 — Metadata of AbstractAppearance (FeatureType)

DEFINITION:	AbstractAppearance is the abstract superclass to represent any kind of appearance objects.
SUBCLASS OF:	AbstractFeatureWithLifespan
STEREOTYPE:	«FeatureType»

Table 105 — Attributes of AbstractAppearance (FeatureType)

ATTRIBUTE	VALUE TYPE AND MULTIPLICITY	DEFINITION
adeOfAbstract Appearance	ADEOfAbstract Appearance [0..*]	Augments AbstractAppearance with properties defined in an ADE.

NOTE: Unless otherwise specified, all attributes and role names have the stereotype «Property».

Figure 69 — Rendering style `data_dictionary` body content part 2 used in OGC 20-010

11.4.4. Section depth

The `section_depth` value specifies the clause depth intended for the automated rendering to occur in Metanorma.

Example: The `section_depth` value of 2 specifies that the location of the `lutaml_uml_datamodel_description` command is at the second level of depth, used to maintain the hierarchy of generated AsciiDoc sections.

11.4.5. Package root depth

The `package_root_depth` value indicates the depth of the automated inclusion process from the root UML package block (an OMG XMI file starts with a UML package as root).

Example: The `package_root_level` value of 2 specifies that the automatic inclusion iterative process starts with UML packages at depth 2 of the XMI.

11.5. Customization options

11.5.1. General

The `[lutaml_uml_datamodel_description]` block allows specification of multiple overriding hooks for users to insert content within the automated rendering process.

11.5.2. Diagrams

The `[.diagram_include_block]` block inside `[lutaml_uml_datamodel_description]` is used to import images generated from EA into the automated rendering process.

The process described Clause 11.2 allows extraction of UML diagrams directly from EA. These UML diagrams however exported into image files named according to an EA-proprietary unique ID, such as `EAID_40625194_4483_46b2_80CF_2756F08865D8.svg`, which are difficult to work with.

The `[.diagram_include_block]` block allows `[lutaml_uml_datamodel_description]` to find the correct figure files through this syntax:

```
[.diagram_include_block, base_path="working-directory/Images", format="svg"]
<1>
....
Text <2>
```

```
....
```

Key

<1> `base_path` specifies the path of the EA-generated images, `format` specifies the file extension of the EA-generated images.

<2> Metanorma AsciiDoc text prior to appearance of the image.

Figure 70 — Including diagrams in the `lutaml_uml_datamodel_description` block

The `base_path` parameter is a mandatory value that specifies the path of the EA-generated images. The path here is relative to the source file location where the `[lutaml_uml_datamodel_description]` block is defined.

For example, this is how a typical OGC MDS directory looks like:

Example 1 — Example of OGC MDS document directory with SVG images

```
+- sources/
  +- images/
  +- document.adoc
  +- model/
    +- export.xmi
    +- UML_EA.dtd
    +- Images/
      +- EAID_40625194_4483_46b2_80CF_2756F08865D8.svg
      +- EAID_76FDCDFB_19E5_47b6_9D21_E6450814059F.svg
```

Using this OGC MDS directory, the following block specification will include the EA-generated images.

Example 2 — Example to include EA-generated SVG images in the `lutaml_uml_datamodel_description` block

```
[.diagram_include_block, base_path="model/Images", format="svg"]
....
....
```

If the EA-generated SVG images are generated with undesired artefacts, the `png` format option can be used. Simply re-generate the images using the “PNG” output format in EA in the same directory.

Example 3 — Example of OGC MDS document directory with PNG images

```
+- sources/
  +- images/
  +- document.adoc
  +- model/
    +- export.xmi
    +- UML_EA.dtd
    +- Images/
      +- EAID_40625194_4483_46b2_80CF_2756F08865D8.png
      +- EAID_76FDCDFB_19E5_47b6_9D21_E6450814059F.png
```

Using this OGC MDS directory, the following block specification will include the EA-generated images.

Example 4 — Example to include EA-generated PNG images in the `lutaml_uml_datamodel_description` block

```
[.diagram_include_block, base_path="model/Images", format="png"]
....
....
```

11.5.3. Before and after blocks

The `[.before]` and `[.after]` blocks in the `[lutaml_uml_datamodel_description]` block allows specifying text before or after every described UML class.

When used by itself, it means that this block applies before or after all packages have been iterated through (`[.before]`, `[.after]`).

A `package` parameter can be given to this block to specify that the block only applies to before or after a particular package in the loop (`[.before, package="Another"]`, `[.after, package="CityGML"]`).

Example — Example of using before and after blocks

```
[.before]
....
Text applies before first package is inspected.
....

[.before, package="CityGML"]
....
Text applies immediately before the CityGML package is inspected.
....

[.after, package="CityGML"]
....
Text applies immediately after the CityGML package is inspected.
....

[.after]
....
Text applies after all packages have been inspected.
....
```

11.5.4. Include block

The `[.include_block]` block allows dynamic insertion of an external file according to the UML package name being inspected.

The syntax is:

```
[.include_block, position="before", base_path="requirements/requirements_class_
"]
--
--
```

Figure 71

Where,

`base_path`	specifies where to find the dynamic file being inserted;
`position=`	(optional) specifies either `before` or `after`;
`package=`	(optional) specifies the UML package match condition.

NOTE: Only `before` and `after` are currently defined as values for `position`.

To use the include block it is necessary to know how the package name is translated into a file name, which file is to be included.

The package name to file name conversion takes these steps:

1. The package name is lowercased;
2. The symbols –, `:` and `` ` `` (whitespace) is converted into _; and
3. The resulting name is prefixed with an underscore (_), appended with the `.adoc` or `.liquid` extension, and the specified `base_path=`.

For example, the UML package name of "MUDDI Core: packages" will be transformed into `{base_path}_muddi_core__packages.[adoc|liquid]`.

The `include_block` is useful for including per UML package content, such as ModSpec requirements, conformance tests and structured content.

```
This is additional text that will be included after the inclusion
of the `spec/fixtures/{include_package_name}` file for every UML
package evaluated.
```

Figure 72-1

```
This is additional text that will be included after the inclusion of
the `spec/fixtures/{include_package_name}` file before the `Another`
package.
```

Figure 72-2

11.5.5. Package block

The `[.package_text]` block in the `[lutaml_uml_datamodel_description]` block allows specifying a block to insert at a particular clause index.

The `[.package_text]` block can take the following forms.

To specify text to be interpolated in predefined positions within each package, use the `position=` and `package=` parameters (`[.package_text, position="after", package="Another"]`).

The syntax is:

```
[.package_text, index="1", position="before", package="Another"]
--
--
```

Figure 73

Where,

`package=`	specifies the UML package match condition;
`position=`	(optional) specifies either `before` or `after`;
`index=`	(optional) if there are multiple `package_text` blocks, define the order of the inserted blocks.

NOTE: Only `before` and `after` are currently defined as values for `position`.

The `package_block` is useful for injecting particular texts or files to the automatically generated content.

Example

```
[.package_text, index="1", position="before", package="Common Spatio-temporal
Classes"]
....
include::clause_7_1_common.adoc[]
....

[.package_text, index="2", position="before", package="Temporal and Zonal
Geometry"]
....
include::clause_7_2_temporal.adoc[]
....

[.package_text, index="1", position="after", package="Temporal and Zonal
Geometry"]
....
=== Defining tables

include::../tables/TAB_cc-st-g-t-i.adoc[]

include::../tables/TAB_cc-st-g-t.adoc[]

The following requirement applies:

include::../requirements/REQ_cc-temporal-geometry.adoc[]
....
```

11.6. Manual rendering (advanced)

For the advanced user who wishes to access data elements beyond the automated process, LutaML provides the `[lutaml]` command that can be used individually to build up an MDS.

NOTE: Using the `[lutaml]` command for MDS will be highly repetitive and require in-depth understand of Liquid templating.

Figure 74 shows an instance of the `[lutaml]` command in Metanorma, which instructs LutaML to process the file in `path/to/file.xmi`, and pass the results of the parse into the object `package`.

The body of the command then iterates through the contents of `package`, and generates Metanorma AsciiDoc using values from the variable.

```
[lutaml,path/to/filelocation.xmi,package]
--
{% for diagram in package.diagrams %}
[[figure-{{ diagram.xmi_id }}]]
.{{ diagram.name }}
image::{{ base_path }}/{{ diagram.xmi_id }}.{{ format | default: 'png' }}[]

{% if diagram.definition %}
{{ diagram.definition | html2adoc }}
{% endif %}
{% endfor %}
--
```

Figure 74 — Rendering of a UML package under LutaML

- The directives in `{% ... %}` are Liquid processing directives, including loops and conditionals.
- The variables referenced in the directives, and invoked through `{{ ... }}`, are attributes parsed by LutaML from the given source files. For example, `package.diagrams` is the list of all diagrams under the current package, and `diagram` is a loop variable containing the parsed information for one such diagram.
- The variable `diagram` contains attributes of its own which LutaML has parsed; the XMI ID attribute for the diagram:
  - `{{ diagram.xmi_id }}` is used in conjunction with the LutaML parameter `{{ image_base_path }}` in order to define the file location of the associated image file;
  - `{{ diagram.xmi_id }}` is also used with the prefix `figure-` to define the anchor for the image (`[[...]]`), to be used in cross-references; and
  - The markup `.{{ diagram.name }}` is used to insert the name attribute of the diagram as the image caption.

11.7. Cross-referencing UML document elements

11.7.1. General

Metanorma provides several commands to enable cross-referencing of MDS-generated document elements.

These particular commands work out of the box when the `default` style of UML rendering is applied.

When using the `entity-list` and `data-dictionary` UML rendering styles, these commands only work under manual circumstances.

11.7.2. UML diagrams

The `[lutaml_figure]` command provides a reference anchor to a figure defined in the XMI file, using its XMI ID for reference.

The syntax is as follows:

```
lutaml_figure::[package="{package-name}",name="{diagram-name}"]
```

Figure 75

Where:

`package-name`	(optional) name of the package where the UML diagram resides in.
`diagram-name`	name of the UML diagram.

If the diagram name is not globally unique across the OMG XMI export, the package name has to be provided for a unique reference.

Example — Usage of `lutaml_figure` (from OGC MUDDI Conceptual Model)

```
The MUDDI core conceptual models are illustrated in
lutaml_figure::[name="MUDDI Conceptual Model",package="Conceptual Model"].
```

When using the `entity-list` and `data-dictionary` UML rendering styles, which do not include any UML diagrams, the figures have to be manually encoded as normal Metanorma figures.

11.7.3. UML definition tables

The `[lutaml_table]` command provides a reference anchor to the definition tables of a particular package, class, enumeration or data type object in the XMI.

The definition tables are automatically generated by the `[lutaml_uml_datamodel_description]` command in the `default` and `data dictionary` rendering styles.

NOTE: The `entity-list` rendering style does not produce any definition tables, and therefore does not support the `[lutaml_table]` command.

The syntax is as follows:

```
lutaml_table::[package="{package-name}"] <1>
lutaml_table::[package="{package-name}",class="{class-name}"] <2>
lutaml_table::[package="Wrapper root package",enum="{enum-name}"] <3>
lutaml_table::[package="Wrapper root package",data_type="{datatype-name}"] <4>
```

Key

<1>	Referencing the definition table for a package.
<2>	Referencing the definition table for a class of a package.
<3>	Referencing the definition table for an enumeration of a package.
<4>	Referencing the definition table for a data type of a package.

Figure 76

Where:

`package-name`	name of the referenced package.
`class-name`	name of the class.
`enum-name`	name of the enumeration.
`datatype-name`	name of the data type.

Example — Usage of `lutaml_table`

```
This is lutaml_table::[package="Wrapper root package"] package
This is lutaml_table::[package="Wrapper root package", class="my name"] class
This is lutaml_table::[package="Wrapper root package", enum="my name"]
enumeration
This is lutaml_table::[package="Wrapper root package", data_type="my name"]
data type
```

12

REQUIREMENTS ON DOCUMENT

12 REQUIREMENTS ON DOCUMENT

12.1. General

The MDS process places certain quality requirements on the document encoding.

REQUIREMENTS CLASS 2: DOCUMENT REQUIREMENTS FOR THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/document`
TARGET TYPE	MDS document
CONFORMANCE CLASS	Conformance class A.2: `/conf/document`
DESCRIPTION	The Metanorma document used for the model-driven standard meets the MDS requirements.
NORMATIVE STATEMENTS	Requirement 4: `/req/document/metadata` Requirement 5: `/req/document/uml-integration` Requirement 6: `/req/document/uml-render-configuration` Requirement 7: `/req/document/uml-cross-references` Requirement 8: `/req/document/modspec`

12.2. Specification of metadata

The MDS document shall be encoded with correct metadata suitable for the OGC model standard.

REQUIREMENT 4: MODEL-BASED DOCUMENT: METADATA VALUES	
IDENTIFIER	`/req/document/metadata`
INCLUDED IN	Requirements class 2: `/req/document`
STATEMENT	The document shall provide suitable metadata for an OGC deliverable that describes an information model.

12.3. UML integration

The MDS document shall integrate with the UML model via an OMG XMI interface.

REQUIREMENT 5: MODEL-BASED DOCUMENT: UML INTEGRATION	
IDENTIFIER	`/req/document/uml-integration`
INCLUDED IN	Requirements class 2: `/req/document`
STATEMENT	The document shall integrate with the UML model via an OMG XMI file.

12.4. UML render configuration

The MDS document shall specify the render conditions and configuration of the UML model.

REQUIREMENT 6: MODEL-BASED DOCUMENT: UML RENDER CONFIGURATION	
IDENTIFIER	`/req/document/uml-render-configuration`
INCLUDED IN	Requirements class 2: `/req/document`
STATEMENT	The document shall specify the render conditions and configuration of the UML model.

12.5. UML cross-references

The MDS document shall utilize methods provided in this document to create cross-references for document elements generated by the automated UML rendering process.

REQUIREMENT 7: MODEL-BASED DOCUMENT: UML CROSS-REFERENCES	
IDENTIFIER	`/req/document/uml-cross-references`

REQUIREMENT 7: MODEL-BASED DOCUMENT: UML CROSS-REFERENCES	
INCLUDED IN	Requirements class 2: `/req/document`
STATEMENT	The document shall utilize methods provided in this document to create cross-references for document elements generated by the automated UML rendering process.

12.6. ModSpec instances

The MDS document shall encode its requirements in a manner compliant with the ModSpec (OGC 08-131r3).

REQUIREMENT 8: MODEL-BASED DOCUMENT: MODSPEC INSTANCES	
IDENTIFIER	`/req/document/modspec`
INCLUDED IN	Requirements class 2: `/req/document`
STATEMENT	The document shall encode its requirements in a manner compliant with the ModSpec.

13

REQUIREMENTS ON UML MODEL

13 REQUIREMENTS ON UML MODEL

13.1. General

The MDS process places certain quality requirements on the involved UML model authored in Sparx Systems Enterprise Architect. This clause describes those requirements.

REQUIREMENTS CLASS 3: COMPLETION OF UML MODEL ANNOTATIONS FOR THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/req/uml`
TARGET TYPE	UML model
CONFORMANCE CLASS	Conformance class A.3: `/conf/uml`
DESCRIPTION	The UML model input for the model-driven standard has been fully annotated to the MDS requirements.
NORMATIVE STATEMENTS	Requirement 9: `/req/uml/package-name` Requirement 10: `/req/uml/package-description` Requirement 11: `/req/uml/package-completeness` Requirement 12: `/req/uml/diagram-name` Requirement 13: `/req/uml/diagram-description` Requirement 14: `/req/uml/diagram-type` Requirement 15: `/req/uml/class-name` Requirement 16: `/req/uml/class-description` Requirement 17: `/req/uml/class-stereotype` Requirement 18: `/req/uml/class-abstract` Requirement 19: `/req/uml/class-constraints` Requirement 20: `/req/uml/property-name` Requirement 21: `/req/uml/property-description` Requirement 22: `/req/uml/property-stereotype` Requirement 23: `/req/uml/property-multiplicity` Requirement 24: `/req/uml/property-type` Requirement 25: `/req/uml/property-constraints` Requirement 26: `/req/uml/datatype-name` Requirement 27: `/req/uml/datatype-description` Requirement 28: `/req/uml/enumeration-name` Requirement 29: `/req/uml/enumeration-description` Requirement 30: `/req/uml/enumeration-value-name` Requirement 31: `/req/uml/enumeration-value-description` Requirement 32: `/req/uml/enumeration-value-type`

REQUIREMENTS CLASS 3: COMPLETION OF UML MODEL ANNOTATIONS FOR THE MODEL-DRIVEN STANDARD	
	Requirement 33: `/req/uml/relationship-specification` Requirement 34: `/req/uml/relationship-multiplicity`

13.2. Package

13.2.1. Name

The package should have a unique name.

REQUIREMENT 9: PACKAGE: ASSIGNMENT OF UNIQUE NAMES	
IDENTIFIER	`/req/uml/package-name`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML package that serves as input to the MDS process is assigned a unique package name as in the EA "Name" property.

13.2.2. Description

The package description should be filled in.

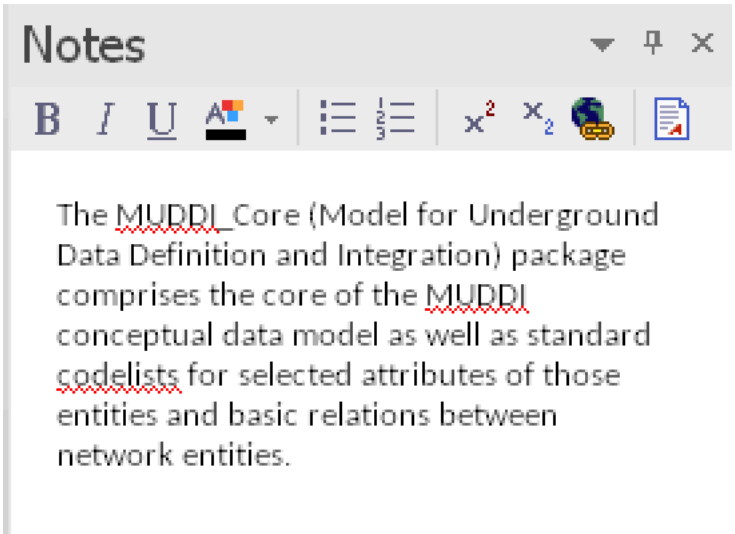


Figure 77

REQUIREMENT 10: PACKAGE: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/package-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML package that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.2.3. Uniqueness

A UML package used in the MDS process should be free of external dependencies, unless remidies are specifically stated in the configuration file.

REQUIREMENT 11: PACKAGE: FREE OF EXTERNAL DEPENDENCIES	
IDENTIFIER	`/req/uml/package-completeness`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML package that serves as input to the MDS process is fully contained in the exported OMG XMI file, and does not depend on any external package not available to the MDS process, unless those external dependencies are configured in the MDS configuration file.

13.3. Diagram

13.3.1. Name

A diagram used in the MDS process has a unique name to enable cross-referencing.

REQUIREMENT 12: DIAGRAM: ASSIGNMENT OF GLOBALLY UNIQUE NAME	
IDENTIFIER	`/req/uml/diagram-name`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML diagram that serves as input to the MDS process is assigned a unique name in the EA “Name” property, global to the scope of the MDS model.

13.3.2. Description

REQUIREMENT 13: DIAGRAM: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/diagram-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML diagram that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.3.3. Type

Sparx Systems Enterprise Architect supports multiple diagram types. In the MDS process, all diagrams are of the “Class” type.

REQUIREMENT 14: DIAGRAM: TYPE OF CLASS	
IDENTIFIER	`/req/uml/diagram-type`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML diagram that serves as input to the MDS process is encoded according to the “Class” diagram type in EA.

13.4. Class

13.4.1. Name

The class should have a unique name within the package it belongs to.

REQUIREMENT 15: CLASS: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/req/uml/class-name`
INCLUDED IN	Requirements class 3: `/req/uml`

REQUIREMENT 15: CLASS: ASSIGNMENT OF UNIQUE NAME	
STATEMENT	Every UML class that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

13.4.2. Description

The class description should be filled in the Notes pane.

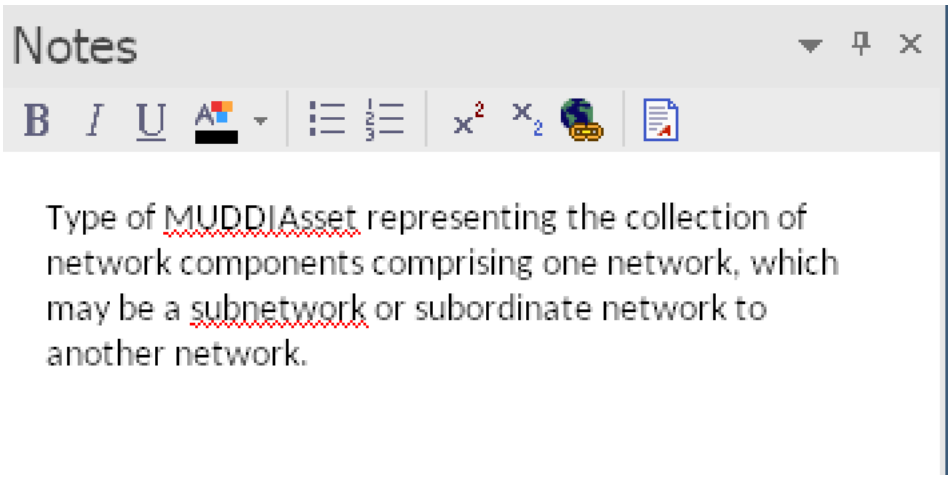


Figure 78

REQUIREMENT 16: CLASS: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/class-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML class that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.4.3. Stereotype

The class stereotype, if any, shall be encoded in the UML class.

REQUIREMENT 17: CLASS: ASSIGNMENT OF STEREOTYPE	
IDENTIFIER	`/req/uml/class-stereotype`
INCLUDED IN	Requirements class 3: `/req/uml`

REQUIREMENT 17: CLASS: ASSIGNMENT OF STEREOTYPE	
STATEMENT	Every UML class that serves as input to the MDS process, that belongs to a particular stereotype, shall have its stereotype encoded in the EA model.

13.4.4. Abstract

If a class is an abstract class, the abstract status in the UML model should reflect that status.

REQUIREMENT 18: CLASS: ABSTRACT STATUS	
IDENTIFIER	`/req/uml/class-abstract`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML class that serves as input to the MDS process if is intended to be abstract shall encode its abstract status in the EA model.

13.4.5. Constraints

UML class constraints should be encoded in the OMG OCL 2.4 language accompanied with an adequate description. This is achieved in Sparx Systems Enterprise Architect through the “Properties” popup, in the “Responsiblities > Constraints” context item.

The version of OCL syntax used shall be documented in the resulting conceptual model and in the OGC deliverable.

REQUIREMENT 19: CLASS: ENCODING OF CLASS CONSTRAINTS	
IDENTIFIER	`/req/uml/class-constraints`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML class that serves as input to the MDS process that contain constraints shall have those constraints encoded in the OCL language with a corresponding description in plain text.

13.5. Property

13.5.1. Name

The property should have a unique name within the class it belongs to.

REQUIREMENT 20: PROPERTY: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/req/uml/property-name`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML property that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

13.5.2. Description

The property description is entered in the Notes pane.

REQUIREMENT 21: PROPERTY: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/property-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML property that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.5.3. Stereotype

The property stereotype, if any, shall be encoded in the UML property.

REQUIREMENT 22: PROPERTY: ASSIGNMENT OF STEREOTYPE	
IDENTIFIER	`/req/uml/property-stereotype`
INCLUDED IN	Requirements class 3: `/req/uml`

REQUIREMENT 22: PROPERTY: ASSIGNMENT OF STEREOTYPE	
STATEMENT	Every UML property that serves as input to the MDS process, that belongs to a particular stereotype, shall have its stereotype encoded in the EA model.

13.5.4. Multiplicity

The multiplicity requirements of the property shall be encoded.

REQUIREMENT 23: PROPERTY: ASSIGNMENT OF MULTIPLICITY	
IDENTIFIER	`/req/uml/property-multiplicity`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML property that serves as input to the MDS process that has multiplicity requirements shall have its multiplicity requirements encoded in the Multiplicity attribute group, including the lower bound, upper bound, whether duplicates are allowed and whether the multiplicity is ordered.

13.5.5. Value types

The value type for a property shall be specified in the UML property.

If there is no value type specified for an property, create an “AbstractValueType” data type with the GML Stereotype “Type”, and assign it to the property (see Figure 79).

Table 14 – Attributes of MUDDIAsset (FeatureType)

Attribute	Value type and multiplicity	Definition
assetOwnerID	AbstractValueType [1..1]	

Figure 79 – Assignment of AbstractValueType to represent an unspecified value type (from: MUDDI Conceptual Model)

REQUIREMENT 24: PROPERTY: ASSIGNMENT OF VALUE TYPE	
IDENTIFIER	`/req/uml/property-type`

REQUIREMENT 24: PROPERTY: ASSIGNMENT OF VALUE TYPE	
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML property that serves as input to the MDS process shall be assigned a value type. If the value type of the property is meant to be abstract (to be implemented by a realization of the property), the UML Class “AbstractValueType” shall be used as its value type.

13.5.6. Constraints

UML property constraints should be encoded in the OMG OCL 2.4 language accompanied with an adequate description. This is achieved in Sparx Systems Enterprise Architect through the “Properties” popup, in the “Responsiblities > Constraints” context item.

The version of OCL syntax used shall be documented in the resulting conceptual model and in the OGC deliverable.

REQUIREMENT 25: PROPERTY: ENCODING OF PROPERTY CONSTRAINTS	
IDENTIFIER	`/req/uml/property-constraints`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML property that serves as input to the MDS process that contain constraints shall have those constraints encoded in the OCL language with a corresponding description in plain text.

13.6. Data type

13.6.1. Name

The data type should have a unique name within the package it belongs to.

REQUIREMENT 26: DATA TYPE: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/req/uml/datatype-name`
INCLUDED IN	Requirements class 3: `/req/uml`

REQUIREMENT 26: DATA TYPE: ASSIGNMENT OF UNIQUE NAME	
STATEMENT	Every UML data type that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

13.6.2. Description

The data type description is entered in the Notes pane.

REQUIREMENT 27: DATA TYPE: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/datatype-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML data type that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.7. Enumeration

13.7.1. Name

The enumeration should have a unique name within the package it belongs to.

REQUIREMENT 28: ENUMERATION: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/req/uml/enumeration-name`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML enumeration that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

13.7.2. Description

The Enumeration description is entered in the Notes pane.

REQUIREMENT 29: ENUMERATION: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/enumeration-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML enumeration that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.8. Enumeration values

13.8.1. Name

The enumeration value should have a unique name within the package it belongs to.

REQUIREMENT 30: ENUMERATION VALUE: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/req/uml/enumeration-value-name`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML enumeration value that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

13.8.2. Description

The enumeration value description is entered in the Notes pane.

REQUIREMENT 31: ENUMERATION VALUE: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/req/uml/enumeration-value-description`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML enumeration value that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

13.8.3. Type

The enumeration value type, if any, shall be encoded in UML.

REQUIREMENT 32: ENUMERATION VALUE: ASSIGNMENT OF TYPE	
IDENTIFIER	`/req/uml/enumeration-value-type`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML enumeration value that serves as input to the MDS process, that has a particular value type, shall have its value type encoded in the EA model.

13.9. Relationships

13.9.1. General

UML elements can be set with multiple relationships. In Sparx Systems Enterprise Architect they are created either as Connectors or Associations.

The following UML Class relationships are often described in a model-driven standard:

Generalization	the target class will be described as a “superclass”, and the source class will be listed as a “subclass” of the target class.
Dependency	the source class will be listed as a “dependency” of the target.
Realization	EA creates Realization relationships from every UML class to the class itself, and these are not rendered in the MDA process.

13.9.2. Specification

REQUIREMENT 33: RELATIONSHIP: COMPLETE SPECIFICATION	
IDENTIFIER	`/req/uml/relationship-specification`
INCLUDED IN	Requirements class 3: `/req/uml`

REQUIREMENT 33: RELATIONSHIP: COMPLETE SPECIFICATION	
STATEMENT	Every UML relationship that serves as input to the MDS process shall be fully specified in the EA model with directionality, type and name.

13.9.3. Multiplicity

REQUIREMENT 34: RELATIONSHIP: COMPLETE SPECIFICATION	
IDENTIFIER	`/req/uml/relationship-multiplicity`
INCLUDED IN	Requirements class 3: `/req/uml`
STATEMENT	Every UML relationship that serves as input to the MDS process shall have be fully specified in the EA model: generalizations, dependencies, realizations, with their names.

A

ANNEX A (NORMATIVE) ABSTRACT TEST SUITE

A

ANNEX A (NORMATIVE) ABSTRACT TEST SUITE

A.1. Core

CONFORMANCE CLASS A.1: IDENTIFICATION OF SOURCE COMPONENTS OF THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/core`
SUBJECT	Model-driven standard
REQUIREMENTS CLASS	Requirements class 1: `/req/core`
DESCRIPTION	Validate that the source components of the model-driven standard are identified and understood.
CONFORMANCE TESTS	Abstract test A.1: `/conf/core/document` Abstract test A.2: `/conf/core/uml` Abstract test A.3: `/conf/core/metadata`

ABSTRACT TEST A.1: READINESS OF OGC DOCUMENT INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/core/document`
REQUIREMENT	Requirement 1: `/req/core/document`
TEST METHOD	Manual inspection
DESCRIPTION	Validate that the OGC document information used in the model-driven standard is completed and made available to the model-driven standard in the Metanorma AsciiDoc format.

ABSTRACT TEST A.2: READINESS OF UML MODEL INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/core/uml`
REQUIREMENT	Requirement 2: `/req/core/uml`
TEST METHOD	Manual inspection
DESCRIPTION	Validate that the UML model used in the model-driven standard is completed and made available to the model-driven standard in the OMG XMI format.

ABSTRACT TEST A.3: READINESS OF OGC DOCUMENT METADATA INFORMATION USED BY THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/core/metadata`
REQUIREMENT	Requirement 3: `/req/core/metadata`
TEST METHOD	Manual inspection
DESCRIPTION	Validate that the OGC document metadata used in the model-driven standard is completed and made available to the model-driven standard in the Metanorma AsciiDoc format.

A.2. Document

CONFORMANCE CLASS A.2: DOCUMENT REQUIREMENTS FOR THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/document`
SUBJECT	MDS document
REQUIREMENTS CLASS	Requirements class 2: `/req/document`
DESCRIPTION	Validate that the Metanorma document used for the model-driven standard meets the MDS requirements.
CONFORMANCE TESTS	Abstract test A.4: `/conf/document/metadata` Abstract test A.5: `/conf/document/uml-integration` Abstract test A.6: `/conf/document/uml-render-configuration` Abstract test A.7: `/conf/document/uml-cross-references` Abstract test A.8: `/conf/document/modspec`

A.3. Specification of metadata

The MDS document shall be encoded with correct metadata suitable for the OGC model standard.

ABSTRACT TEST A.4: MODEL-BASED DOCUMENT: METADATA VALUES	
IDENTIFIER	`/conf/document/metadata`
REQUIREMENT	Requirement 4: `/req/document/metadata`
TEST METHOD	Manual inspection
DESCRIPTION	Check that the document shall provide suitable metadata for an OGC deliverable that describes an information model.

ABSTRACT TEST A.5: MODEL-BASED DOCUMENT: UML INTEGRATION	
IDENTIFIER	`/conf/document/uml-integration`
REQUIREMENT	Requirement 5: `/req/document/uml-integration`
TEST METHOD	Manual inspection
DESCRIPTION	Check that the document shall integrate with the UML model via an OMG XMI file.

ABSTRACT TEST A.6: MODEL-BASED DOCUMENT: UML RENDER CONFIGURATION	
IDENTIFIER	`/conf/document/uml-render-configuration`
REQUIREMENT	Requirement 6: `/req/document/uml-render-configuration`
TEST METHOD	Manual inspection
DESCRIPTION	Check that the document shall specify the render conditions and configuration of the UML model.

ABSTRACT TEST A.7: MODEL-BASED DOCUMENT: UML CROSS-REFERENCES	
IDENTIFIER	`/conf/document/uml-cross-references`
REQUIREMENT	Requirement 7: `/req/document/uml-cross-references`
TEST METHOD	Manual inspection
DESCRIPTION	Check that the document shall utilize methods provided in this document to create cross-references for document elements generated by the automated UML rendering process.

ABSTRACT TEST A.8: MODEL-BASED DOCUMENT: MODSPEC INSTANCES	
IDENTIFIER	`/conf/document/modspec`
REQUIREMENT	Requirement 8: `/req/document/modspec`
TEST METHOD	Manual inspection
DESCRIPTION	Check that the document shall encode its requirements in a manner compliant with the ModSpec.

A.4. UML

CONFORMANCE CLASS A.3: COMPLETION OF UML MODEL ANNOTATIONS FOR THE MODEL-DRIVEN STANDARD	
IDENTIFIER	`/conf/uml`
REQUIREMENTS CLASS	Requirements class 3: `/req/uml`
DESCRIPTION	The UML model input for the model-driven standard is validated to fully provide annotations that suit MDS requirements.
CONFORMANCE TESTS	Abstract test A.9: `/conf/uml/package-name` Abstract test A.10: `/conf/uml/package-description` Abstract test A.11: `/conf/uml/package-completeness` Abstract test A.12: `/conf/uml/diagram-name` Abstract test A.13: `/conf/uml/diagram-description` Abstract test A.14: `/conf/uml/diagram-type` Abstract test A.15: `/conf/uml/class-name` Abstract test A.16: `/conf/uml/class-description`

CONFORMANCE CLASS A.3: COMPLETION OF UML MODEL ANNOTATIONS FOR THE MODEL-DRIVEN STANDARD	
	Abstract test A.17: /conf/uml/class-stereotype Abstract test A.18: /conf/uml/class-abstract Abstract test A.19: /conf/uml/class-constraints Abstract test A.20: /conf/uml/property-name Abstract test A.21: /conf/uml/property-description Abstract test A.22: /conf/uml/property-stereotype Abstract test A.23: /conf/uml/property-multiplicity Abstract test A.24: /conf/uml/property-type Abstract test A.25: /conf/uml/property-constraints Abstract test A.26: /conf/uml/datatype-name Abstract test A.27: /conf/uml/datatype-description Abstract test A.28: /conf/uml/enumeration-name Abstract test A.29: /conf/uml/enumeration-description Abstract test A.30: /conf/uml/enumeration-value-name Abstract test A.31: /conf/uml/enumeration-value-description Abstract test A.32: /conf/uml/enumeration-value-type Abstract test A.33: /conf/uml/relationship-specification Abstract test A.34: /conf/uml/relationship-multiplicity

ABSTRACT TEST A.9: TEST PACKAGE: ASSIGNMENT OF UNIQUE NAMES	
IDENTIFIER	/conf/uml/package-name
REQUIREMENT	Requirement 9: /req/uml/package-name
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML package that serves as input to the MDS process is assigned a unique package name as in the EA “Name” property.

ABSTRACT TEST A.10: TEST PACKAGE: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	/conf/uml/package-description
REQUIREMENT	Requirement 10: /req/uml/package-description
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML package that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.11: TEST PACKAGE: FREE OF EXTERNAL DEPENDENCIES

IDENTIFIER	`/conf/uml/package-completeness`
REQUIREMENT	Requirement 11: `/req/uml/package-completeness`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML package that serves as input to the MDS process is fully contained in the exported OMG XMI file, and does not depend on any external package not available to the MDS process, unless those external dependencies are configured in the MDS configuration file.

ABSTRACT TEST A.12: TEST DIAGRAM: ASSIGNMENT OF GLOBALLY UNIQUE NAME

IDENTIFIER	`/conf/uml/diagram-name`
REQUIREMENT	Requirement 12: `/req/uml/diagram-name`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML diagram that serves as input to the MDS process is assigned a unique name in the EA “Name” property, global to the scope of the MDS model.

ABSTRACT TEST A.13: TEST DIAGRAM: ASSIGNMENT OF DESCRIPTION

IDENTIFIER	`/conf/uml/diagram-description`
REQUIREMENT	Requirement 13: `/req/uml/diagram-description`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML diagram that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.14: TEST DIAGRAM: TYPE OF CLASS

IDENTIFIER	`/conf/uml/diagram-type`
REQUIREMENT	Requirement 14: `/req/uml/diagram-type`
TEST METHOD	Manual inspection

ABSTRACT TEST A.14: TEST DIAGRAM: TYPE OF CLASS	
DESCRIPTION	Check that every UML diagram that serves as input to the MDS process is encoded according to the “Class” diagram type in EA.

ABSTRACT TEST A.15: TEST CLASS: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/conf/uml/class-name`
REQUIREMENT	Requirement 15: `/req/uml/class-name`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML class that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

ABSTRACT TEST A.16: TEST CLASS: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/conf/uml/class-description`
REQUIREMENT	Requirement 16: `/req/uml/class-description`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML class that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.17: TEST CLASS: ASSIGNMENT OF STEREOTYPE	
IDENTIFIER	`/conf/uml/class-stereotype`
REQUIREMENT	Requirement 17: `/req/uml/class-stereotype`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML class that serves as input to the MDS process, that belongs to a particular stereotype, shall have its stereotype encoded in the EA model.

ABSTRACT TEST A.18: TEST CLASS: ABSTRACT STATUS

IDENTIFIER	`/conf/uml/class-abstract`
REQUIREMENT	Requirement 18: `/req/uml/class-abstract`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML class that serves as input to the MDS process if is intended to be abstract shall encode its abstract status in the EA model.

ABSTRACT TEST A.19: TEST CLASS: ENCODING OF CLASS CONSTRAINTS

IDENTIFIER	`/conf/uml/class-constraints`
REQUIREMENT	Requirement 19: `/req/uml/class-constraints`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML class that serves as input to the MDS process that contain constraints shall have those constraints encoded in the OCL language with a corresponding description in plain text.

ABSTRACT TEST A.20: TEST PROPERTY: ASSIGNMENT OF UNIQUE NAME

IDENTIFIER	`/conf/uml/property-name`
REQUIREMENT	Requirement 20: `/req/uml/property-name`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML property that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

ABSTRACT TEST A.21: TEST PROPERTY: ASSIGNMENT OF DESCRIPTION

IDENTIFIER	`/conf/uml/property-description`
REQUIREMENT	Requirement 21: `/req/uml/property-description`
TEST METHOD	Manual inspection

ABSTRACT TEST A.21: TEST PROPERTY: ASSIGNMENT OF DESCRIPTION	
DESCRIPTION	Check that every UML property that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.22: TEST PROPERTY: ASSIGNMENT OF STEREOTYPE	
IDENTIFIER	`/conf/uml/property-stereotype`
REQUIREMENT	Requirement 22: `/req/uml/property-stereotype`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML property that serves as input to the MDS process, that belongs to a particular stereotype, shall have its stereotype encoded in the EA model.

ABSTRACT TEST A.23: TEST PROPERTY: ASSIGNMENT OF MULTIPLICITY	
IDENTIFIER	`/conf/uml/property-multiplicity`
REQUIREMENT	Requirement 23: `/req/uml/property-multiplicity`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML property that serves as input to the MDS process that has multiplicity requirements shall have its multiplicity requirements encoded in the Multiplicity attribute group, including the lower bound, upper bound, whether duplicates are allowed and whether the multiplicity is ordered.

ABSTRACT TEST A.24: TEST PROPERTY: ASSIGNMENT OF VALUE TYPE	
IDENTIFIER	`/conf/uml/property-type`
REQUIREMENT	Requirement 24: `/req/uml/property-type`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML property that serves as input to the MDS process shall be assigned a value type. If the value type of the property is meant to be abstract (to be implemented by a realization of the property), the UML Class “AbstractValueType” shall be used as its value type.

ABSTRACT TEST A.25: TEST PROPERTY: ENCODING OF PROPERTY CONSTRAINTS

IDENTIFIER	`/conf/uml/property-constraints`
REQUIREMENT	Requirement 25: `/req/uml/property-constraints`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML property that serves as input to the MDS process that contain constraints shall have those constraints encoded in the OCL language with a corresponding description in plain text.

ABSTRACT TEST A.26: TEST DATA TYPE: ASSIGNMENT OF UNIQUE NAME

IDENTIFIER	`/conf/uml/datatype-name`
REQUIREMENT	Requirement 26: `/req/uml/datatype-name`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML data type that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

ABSTRACT TEST A.27: TEST DATA TYPE: ASSIGNMENT OF DESCRIPTION

IDENTIFIER	`/conf/uml/datatype-description`
REQUIREMENT	Requirement 27: `/req/uml/datatype-description`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML data type that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.28: TEST ENUMERATION: ASSIGNMENT OF UNIQUE NAME

IDENTIFIER	`/conf/uml/enumeration-name`
REQUIREMENT	Requirement 28: `/req/uml/enumeration-name`
TEST METHOD	Manual inspection

ABSTRACT TEST A.28: TEST ENUMERATION: ASSIGNMENT OF UNIQUE NAME	
DESCRIPTION	Check that every UML enumeration that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

ABSTRACT TEST A.29: TEST ENUMERATION: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/conf/uml/enumeration-description`
REQUIREMENT	Requirement 29: `/req/uml/enumeration-description`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML enumeration that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.30: TEST ENUMERATION VALUE: ASSIGNMENT OF UNIQUE NAME	
IDENTIFIER	`/conf/uml/enumeration-value-name`
REQUIREMENT	Requirement 30: `/req/uml/enumeration-value-name`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML enumeration value that serves as input to the MDS process has its name encoded in the EA “Name” attribute in plain text.

ABSTRACT TEST A.31: TEST ENUMERATION VALUE: ASSIGNMENT OF DESCRIPTION	
IDENTIFIER	`/conf/uml/enumeration-value-description`
REQUIREMENT	Requirement 31: `/req/uml/enumeration-value-description`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML enumeration value that serves as input to the MDS process has its description encoded in the EA “Notes” pane in plain text.

ABSTRACT TEST A.32: TEST ENUMERATION VALUE: ASSIGNMENT OF TYPE

IDENTIFIER	`/conf/uml/enumeration-value-type`
REQUIREMENT	Requirement 32: `/req/uml/enumeration-value-type`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML enumeration value that serves as input to the MDS process, that has a particular value type, shall have its value type encoded in the EA model.

ABSTRACT TEST A.33: TEST RELATIONSHIP: COMPLETE SPECIFICATION

IDENTIFIER	`/conf/uml/relationship-specification`
REQUIREMENT	Requirement 33: `/req/uml/relationship-specification`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML relationship that serves as input to the MDS process shall be fully specified in the EA model with directionality, type and name.

ABSTRACT TEST A.34: TEST RELATIONSHIP: COMPLETE SPECIFICATION

IDENTIFIER	`/conf/uml/relationship-multiplicity`
REQUIREMENT	Requirement 34: `/req/uml/relationship-multiplicity`
TEST METHOD	Manual inspection
DESCRIPTION	Check that every UML relationship that serves as input to the MDS process shall have be fully specified in the EA model: generalizations, dependencies, realizations, with their names.

B

ANNEX B (INFORMATIVE) CHECKLISTS TO COMPLETE

B ANNEX B (INFORMATIVE) CHECKLISTS TO COMPLETE

This is a simple checklist for authors and editors of model-driven standards to ensure that the source model is suitable for the model-driven standards generation process.

Table B.1

DESCRIPTION	DONE?
For the UML model, please verify that the conformance class in Annex A is satisfied.	...
Follow the OMG XMI export instructions to generate a compliant XMI for the MDS process.	...
Decide on the UML rendering style. Does this MDS document need to deal with backwards compatibility? If not, please utilize the `default` option.	...
If the MDS document contain requirements, those requirements have to conform to the ModSpec.	...
Does the MDS document use OCL? If so, ensure that the MDS document include a specification of the OCL version.	...

C

ANNEX C (INFORMATIVE) EXAMPLE OGC MDS DOCUMENT

C

ANNEX C
(INFORMATIVE)
EXAMPLE OGC MDS DOCUMENT

An example document, derived from the OGC MUDDI Conceptual Model, will be provided at the following location:

- http://github.com/opengeospatial/

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BIBLIOGRAPHY

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