SLOVENSKI STANDARD
SIST EN 17632-1:2023

01-april-2023

Informacijsko modeliranje gradenj (BIM) - Semantični standard za modeliranje in povezovanje (SML) - 1. del: Generični vzorci modeliranja

Building Information Modelling (BIM) - Semantic Modelling and Linking (SML) - Part 1: Generic modelling patterns

Semantischer Modellierungs- und Verknüpfungsstandard (SMLS) für die Datenintegration in der gebauten Umwelt

Modélisation d'informations de la construction (BIM) - Modélisation et liens sémantiques (SML) - Partie 1 : Schémas de modélisation génériques

Ta slovenski standard je istoveten z: **EN 17632-1:2022**

ICS:

35.240.67	Uporabniške rešitve IT v gradbeništvu	IT applications in building and construction industry
91.010.01	Gradbeništvo na splošno	Construction industry in general

SIST EN 17632-1:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 17632-1

December 2022

ICS 35.240.67

English Version

Building information modelling (BIM) - Semantic modelling and linking (SML) - Part 1: Generic modelling patterns

Modélisation d'informations de la construction (BIM) - Modélisation et liaisons sémantiques (SML) - Partie 1 : Schémas de modélisation génériques

Semantischer Modellierungs- und Verknüpfungsstandard (SMLS) für die Datenintegration in der gebauten Umwelt

This European Standard was approved by CEN on 12 September 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 17632-1:2022 E

Contents

Page

European foreword

This document (EN 17632-1:2022) has been prepared by Technical Committee CEN/TC 422 “Building information modelling (BIM)”, the secretariat of which is held by SN - Norway.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document is about the built environment. In the built environment, assets relating to buildings and infrastructures need to be managed across their entire life cycle, involving programming, design, construction, operation, modification and demolition or disassembly. Vast amounts of valuable information about them are created or captured, stored and communicated according to a diverse range of forms and structures - and often lost again.

To manage these projects and their resulting assets more efficiently and effectively, information needs to be findable, accessible, interoperable and reusable (FAIR). The world wide web consortium (W3C) provides open and generic linked data (LD) and semantic web (SW) technologies [1] which are capable of providing this 'FAIRness' giving information a common form ('syntax') and structure ('semantics').

Using the 'new European Interoperability Framework' (EIF) [9] terminology, this document focuses on syntactic and semantic interoperability.

This document specifies how organizations in the built environment can apply this W3C technology to best suit their needs. For example, it can be used within organizations to communicate information internally between various business departments and software, or it can be used externally to publish information across the multitude of databases and organizations in the sector.

Application of this document will in particular help to align and integrate relevant 'modelling worlds' for the built environment, typically involving already existing complex information models, like in Building Information Modelling (BIM), Geographical Information Systems (GIS), Systems Engineering (SE), Monitoring & Control (M&C) and Electronic Document Management (EDM).

Regarding to BIM Building Information Modelling, this document has been prepared with the EN ISO 16739-1 [11] Industry Foundation Classes (IFC) information model in mind, and it has been aligned with the revision work of EN ISO 12006-3 [17] (used to extend IFC via a buildingSmart data dictionary (bSDD)). More specifically, this document offers a 'linked data' view on the 'data templates' related to CEN TC442/WG4. It provides a way to represent the 'attributes' for 'properties' of EN ISO 23386:2020 [15] implemented according to EN ISO 23387:2020 [16], again involving EN ISO 12006-3.

As any other technical specification, this document requires expertise and experience in specifying, procuring and delivering work results. As semantic modelling and linking is in the domain of computer science, the content is aimed at those professionals. This document however, provides a standardized approach for the built environment, and thus this introduction addresses the sector and its decision makers.

Wherever the sector could benefit from better ways of searching, finding and (re)using information, this document specifies how to store, model, publish and link this information, with the aim of modelling information once in a standardized way, instead of adapting and transforming information on an ad hoc basis. In other words, it is not a matter of shifting information structures already in place, but a matter of modelling them for publishing on the Web/internet in more cloud-native ways.

The key principle of this document is to keep semantic modelling as simple and standardized as possible. The objectives for capability range from machine-readable information (interpreted by humans) via (as far as possible) machine-interpretable information to fully integrated and interlinked information sources.

This document is complementary to other ISO standards. In the Annex D, related ISO standards are listed and the exact relationships are described.

The standardized modelling patterns introduced in this document may be applicable to other industry sectors as well.

1 Scope

This document addresses *syntactic and semantic interoperability* for information describing assets going through their life cycle in the built environment. It assumes the underlying *technical interoperability* provided already by the Internet/World Wide Web (WWW) technology-stack. The syntactic aspects relate to the Linked Data (LD)/Semantic Web (SW) formats and the SPARQL direct access method provided. The semantic aspects relate to the LD/SW-based information models in the form of thesauri and ontologies giving meaning to the information.

The following information architecture (Figure 1) applies.

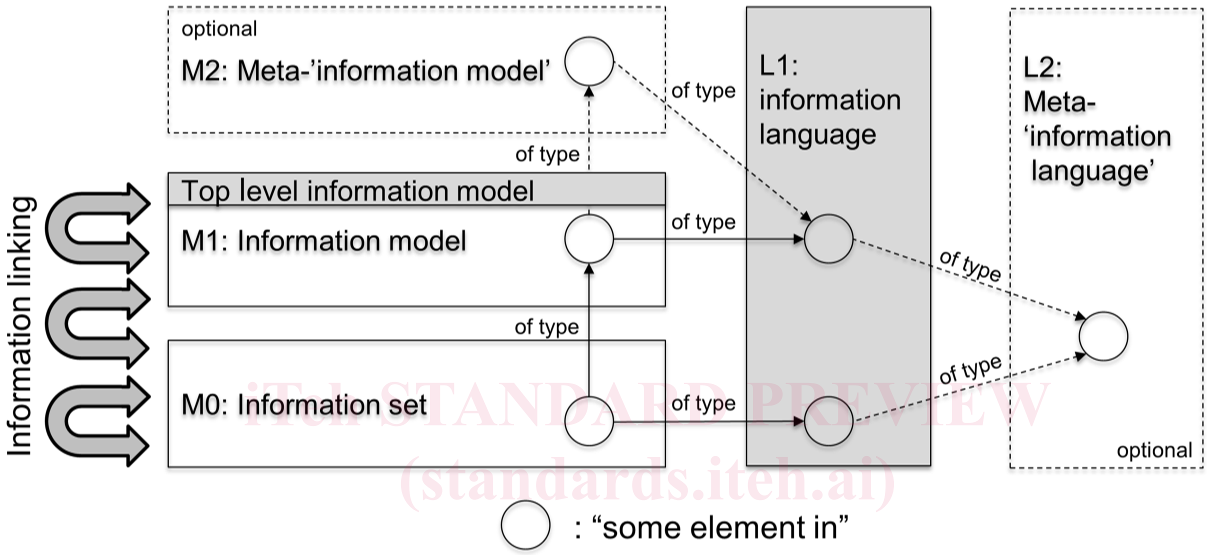

Figure 1 — Information architecture with (grey areas indicating the scope of this document)

This document specifies:

— a conceptual "L1: Information language" with four RDF-based language bindings being SKOS, RDFS, OWL and SHACL, including:

— a choice of 'linked data'/RDF-based formats (to be used for all modelling and language levels); and

— a generic Top Level Information Model of a total "M1: Information model", here "an upper ontology", including:

— a set of generic information modelling patterns for identification, annotation, enumeration datatypes, complex quality/quantity modelling, decomposition and grouping.

This modelling approach for information models and information sets is relevant within the built environment from multiple perspectives such as:

— Building information modelling (BIM);

— Geographical information systems (GIS);

— Systems engineering (SE);

— Monitoring & control (M&C); and

— Electronic document management (EDM).

Annex E discusses in an informative way how the information models and sets relevant for these different worlds can be linked together using LD/SW technology.

This document does not specify a full meta-'information model', sometimes referred to as a 'Knowledge Model (KM)'. EN ISO 12006-3 provides such an often used model for the built environment. In Annex D, Subclause D.3 it is shown how this existing model can be made compliant to this document. The only direct support for this meta level comes in the form of the possibility to define 'types' (enumeration types or concept types) and 'objectifications' as metaconcepts.

This document does not specify a meta-'information language' since this is already provided by the concrete RDF-based language bindings (being RDFS).

The scope of this document in general excludes the following:

— Business process modelling;

— Software implementation aspects;

— Information packaging and transportation/transaction aspects already handled by ISO TC59/SC13 Information container for linked document delivery (ICDD) ([13]) respectively various information delivery manual (IDM) / information exchange requirements (EIR)-related initiatives; and

— Domain-specific (here: 'built environment'-specific) content modelling in the form of concepts, attributes and relations at end-user level (the actual ontologies themselves) beyond a generic top level information model ('upper ontology') and modelling and linking patterns.

2 Normative references

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

JSON-LD 1.1, A JSON-based Serialization for Linked Data, W3C Recommendation, 16 July 2020, https://www.w3.org/TR/json-ld11/

OWL 2[1] Web Ontology Language, Document Overview (Second Edition), W3C Recommendation, 11 December 2012, https://www.w3.org/TR/2012/REC-owl2-overview-20121211/

RDF 1.1 Concepts and Abstract Syntax, W3C Recommendation, 25 February 2014, https://www.w3.org/TR/rdf11-concepts/

RDF 1.1 Turtle, W3C Recommendation, 25 February 2014, https://www.w3.org/TR/turtle/

RDF 1.1 XML Syntax, W3C Recommendation 25 February 2014, https://www.w3.org/TR/rdf-syntax-grammar/

RDF Schema 1.1, W3c Recommendation, 25 February 2014, https://www.w3.org/TR/rdf-schema/

SHACL (Shapes Constraint Language). W3C Recommendation, 20 July 2017, https://www.w3.org/TR/shacl/

SKOS Simple Knowledge Organization System Reference. W3C Recommendation, 18 August 2009, https://www.w3.org/TR/skos-reference/

[1] Hereafter referred to as just "OWL".

SPARQL 1.1 Overview, 21 March 2013, W3C Recommendation, https://www.w3.org/TR/sparql11-overview/ (referencing, among others, the next two, more specific, references)

SPARQL 1.1 Query Language, W3C Recommendation, 21 March 2013, https://www.w3.org/TR/2013/REC-sparql11-query-20130321/

SPARQL 1.1 Protocol, W3C Recommendation, 21 March 2013, https://www.w3.org/TR/sparql11-protocol/

XML Schema Part 2: Datatypes, Second Edition, W3C Recommendation, 28 October 2004, https://www.w3.org/TR/xmlschema-2/

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1 and the following apply.

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

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

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

3.1
asset
item, thing or entity that has potential or actual value to an organization

[SOURCE: ISO 55000:2014, 3.2.1, modified – Note 1, 2 and 3 to entry have been removed.]

3.2
attribute
inherent characteristic

Note 1 to entry: The term used in EN ISO 12006-3 is xtdProperty.

[SOURCE: EN ISO 9241-302:2008, 3.4.2, modified – Note 1 to entry has been added.]

3.3
built environment
collection of man-made or induced physical objects located in a particular area or region

[SOURCE: ISO 6707-3:2017, 3.1.3]

3.4
closed-world assumption
CWA
assumption, in a formal system of logic used for knowledge representation that a statement that is true is also known to be true; therefore, conversely, what is not currently known to be true is false

Note 1 to entry: Typically combined with the Unique Name Assumption (UNA).

3.5
concept
abstract entity for determining category membership

[SOURCE: ISO/IEC 2382:2015, 2122971]

3.6
data format
predetermined arrangement of data on a data medium

[SOURCE: ISO 5127:2017, 3.1.13.12]

3.7
exchange information requirement
EIR
information requirement in relation to an appointment

[SOURCE: EN ISO 19650-1:2018, 3.3.6]

3.8
hierarchy
concept system in which all concepts are related in hierarchical relations that form a partial ordering

[SOURCE: ISO/IEC TR 11179-2:2019, 3.8]

3.9
information model
data model
description of the organization of information giving structure/meaning ('semantics') to an information set

3.10
information set
data set
named collection of information describing or specifying something you can or could point at in reality

3.11
level of capability
LoC
semantic modelling power provided by the 'linked data' languages related to the needs of a specific use case type

3.12
machine-interpretable
able to (to a certain extent) be semantically interpreted by a computer

3.13
machine-readable
able to be read and processed by a computer

3.14
meronomy
type of hierarchy which deals with part-whole relationships

[SOURCE: ISO/IEC 11179-3:2013, 3.2.73]

3.15
metadata
data about data (documents, information sets, information models or elements in those)

3.16
n-ary
having an arity of n

3.17
object
any part of the perceivable or conceivable world

Note 1 to entry: An object is something abstract or physical toward which thought, feeling, or action is directed.

Note 2 to entry: Within this document, the term individual is used as synonym of object.

[SOURCE: EN ISO 12006-2:2020, 3.1.1, modified – added Note 1 and Note 2 to entry.]

3.18
ontology
formal, explicit specification of a shared conceptualization

Note 1 to entry: An ontology typically includes definitions of concepts and specified relationships between them, set out in a formal way so that a machine can use them for reasoning.

[SOURCE: ISO 25964-2:2013, definition 3.57]

Note 2 to entry: See also ISO/TR 13054:2012, definition 2.6; ISO/TS 13399-4:2014, definition 3.20; ISO 19101-1:2014, definition 4.1.26; ISO 18435-3:2015, definition 3.1; ISO/IEC 19763-3:2010, definition 3.1.1.1.

Note 3 to entry: Applied in this document as a set of concepts, reference individuals, value types, reference values, attributes, relations, constraints and derivations.

[SOURCE: ISO 5127:2017, 3.1.2.03, modified – added Note 3 to entry.]

3.19
open-world assumption
OWA
opposite of the closed-world assumption stating that lack of knowledge does not imply falsity

Note 1 to entry: typically combined with the No Unique Name Assumption (NO-UNA).

3.20
property
attribute or a relation

Note 1 to entry: This is also the term used in RDF (rdf:Property).

3.21
relation
relationship
sense in which concepts can be connected, via constituent roles

Note 1 to entry: The related concepts may be general or individual concepts.

Note 2 to entry: The term used in EN ISO 12006-3 is xtdRelationshipToSubject.

EXAMPLE Causality is a relation with two constituent roles: cause and effect.

[SOURCE: ISO/IEC 11179-3:2013, 3.2.119, modified – added Note 2 to entry.]

3.22
systems engineering
SE
interdisciplinary approach governing the total technical and managerial effort required to transform a set of stakeholder needs, expectations, and constraints into a solution and to support that solution throughout its life

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.65]

3.23
taxonomy
type of hierarchy which deals with generalization/specialization relationships

[SOURCE: ISO/IEC 11179-3:2013, 3.2.135]

3.24
top level information model
generic part of an information model (typically a generic taxonomy)

3.25
triple
statement in the form subject-predicate-object that expresses a fact

3.26
typology
type of hierarchy which deals with classification/instantiation relationships

3.27
use case
sequence of actions that an actor (usually a person, but perhaps an external entity, such as another system) performs within a system to achieve a particular goal

[SOURCE: ISO/TR 17185-3:2015, 3.17; ISO/TR 25102, modified]

4 Symbols and abbreviated terms

4.1 Symbols

This document does not contain any symbols.

4.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

API	application programming interface
BIM	building information modelling
bSDD	buildingSmart data dictionary
CWA	closed world assumption
ECMA	European computer manufacturers association international
EDM	electronic document management
EIF	European interoperability framework

EIR	exchange information requirements
FAIR	findable, accessible, interoperable, reusable [go-fair.org]
GIS	geographical information systems
GUID	globally unique identifier (typically assigned)
ICDD	information container for linked document delivery [ISO]
IDM	information delivery manual
IFC	industry foundation classes [ISO]
IETF	internet engineering task force
JSON	JavaScript object notation [ECMA]
JSON-LD	JavaScript object notation - linked data [W3C]
LD	linked data (technology) [W3C]
LoC	level of capability
M&C	monitoring & control
OMG	object management group
OWA	open world assumption
OWL	web ontology language [W3C]
QUDT	quantities, units, dimensions and data types [qudt.org]
RDF	resource description framework [W3C]
RDFS	resource description framework schema [W3C]
RFC	request for comments [IETF]
SE	systems engineering
SHACL	shapes constraints language [W3C]
SML	semantic modelling and linking [CEN]
SPARQL	sparql protocol and RDF query language [W3C]
SPFF	step physical file format [STEP]
SSoF	single source of facts
STEP	standard for the exchange of product model data [ISO]
SW	semantic web (technology) [W3C]
UML	unified modelling language [OMG]
URI	uniform resource identifier [W3C]
UUID	universally unique identifier [IETF]
XML	extensible markup language [W3C]
XSD	extensible markup language schema definition [W3C]
W3C	world wide web consortium
WWW	world wide web [W3C]

5 Semantic modelling levels of capability

An appointing party shall define the levels of capability required for each use case.

Different use case types need different ‘levels of (semantic modelling) capability’ (LoC) related to the required modelling power. This document specifies three main LoCs (Figure 2).

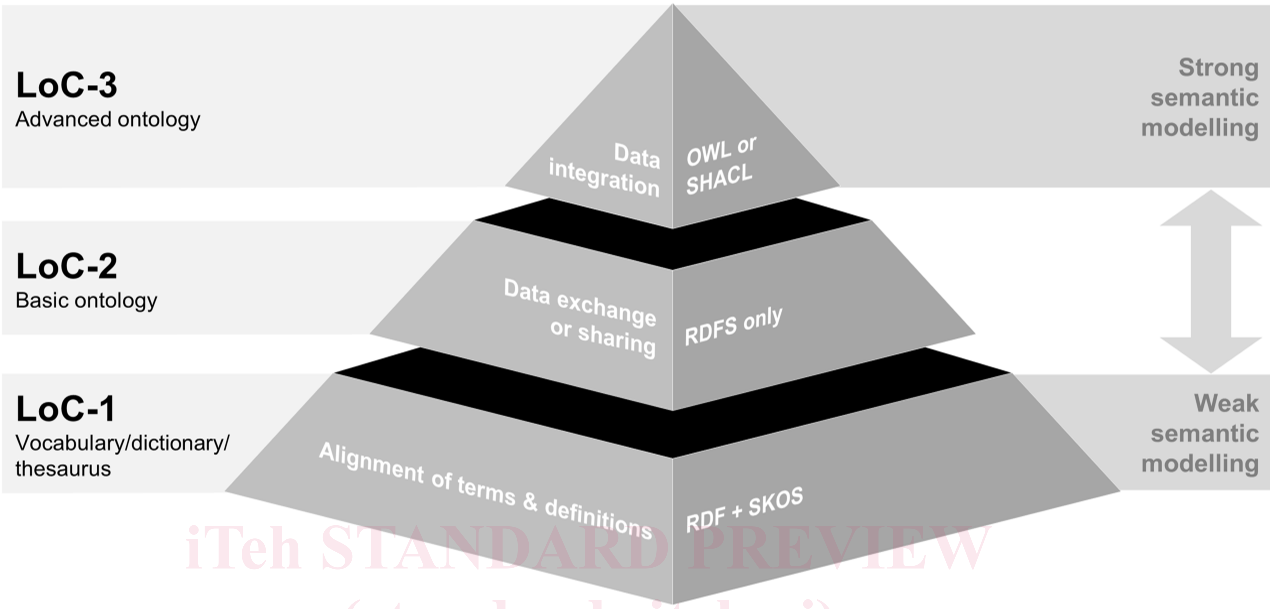

Figure 2 — Three use case types and related 'Levels of (semantic modelling) Capability’ (LoCs)'

The left part of Figure 2 represents the organizational use case type activity, the right side the related (linked data) modelling languages available. The simplest use case type, requiring the weakest semantic modelling, is the common understanding and *alignment of terms and definitions* used to describe assets, their environment and internal structure. Weak modelling is sufficient here as a first step especially targeted towards human interpretation. A good definition gives an end user guidance on how to later classify and instantiate their information according to these terms. This level targets common human understanding of terms and definitions and at least making sure the information is machine-*readable*. Terms and definitions can be distributed as well as published on websites for others to refer to and reuse. For this LoC-1 the RDF framework and the SKOS language shall be used.

More expressive power is needed whenever common understanding is required for the *exchange or sharing of* asset information between digital systems (within or between parties). This can achieved with LoC-2 where information is classified according to basic ontologies involving concepts, valuetypes, attributes and relations and restrictions. This stronger level builds upon the lowest level making the information also machine-*interpretable*. Because of this adding of semantics, limited automatic inference of information from asserted information becomes possible. For this LoC-2 the RDF framework and the RDFS language shall be used.

NOTE 1 OWL is defined on top of RDFS and is providing more modelling power than RDFS by introducing ‘restrictions’ that can be used to infer new information from asserted information.

The term ‘machine-interpretable’ should be understood in an informal sense.

NOTE 2 Machine-interpretation like humans do would ultimately require understanding of all the names and labels used for the concepts, attributes and relations. At least the ontologies provide a level of structure defining the possibilities and impossibilities for the data provided giving some machine-interpretable meaning to the information.