

**Building information models – Information delivery manual – Part3: Data
schema and code**

WD stage 20.00

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization of information about construction works*.

A list of all parts in the ISO 29481 series can be found on the ISO website.

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

Introduction

This document defines the international standard data schema and classification for the efficient identification, management, and reuse of the ISO 29481-1 (information delivery manual, IDM) specifications.

ISO 29481-1 (IDM) sets out a methodology for describing the processes and data requirements for a defined purpose within the development or management of a constructed facility. The IDM specifications, however, have been developed as a static document file or as a data file specified in a proprietary data format, and thus their contents cannot be efficiently exchanged, shared, and reused due to the lack of a standard data schema for exchanging and sharing the contents of IDM specifications in an electronic format. The goal of ISO 29481-3 is to expedite the development and sharing of the IDM specifications to meet the rapidly increasing demand for various building information modelling (BIM) use cases.

This document specifies a data schema for authoring, exchanging, and sharing an IDM specification defined by ISO 29481-1 in the XML (eXtensible Markup Language). The data schema is referred to as the idmXML schema definition (idmXSD). idmXSD aims to allow users to electronically store, search, share, and exchange IDM specifications and their contents, including meta-data such as authors, dates, languages, revision history, supported project phases, and detailed descriptions of each information requirement. In addition, this document specifies the IDM code generation rules based on their key properties.

This standard improves the interoperability of IDM specifications and their contents, providing tight digital links between the components of an IDM specification; and to external data definitions such as ISO 16739-1 (industry foundation classes, IFC), ISO 12006-3, ISO 19650-1, CEN EN 17412-1 (Level of Information Need), and model view definitions (MVDs) of standard data schemas.

Building information models — Information delivery manual —

Part 3: Data schema and classification

1 Scope

This part of ISO 29481 is an interpretation of the requirements by ISO 29481-1 (IDM) as a data schema in the XML form.

2 Normative references

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

ISO/IEC Directives Part 1:2020 Procedures for the technical work

ISO 639-1:2002, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

ISO 3166-1:2020, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 8601-1:2019, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO/IEC 9834-8:2005, *Information Technology — Open Systems Interconnection*

ISO 29481-1:2016, *Buildings information modelling — Information delivery manual — Part 1: Methodology and format*

ISO 12006-2:2015, *Building construction — Organization of information about construction works — Part 2: Framework for classification*

ISO 22263:2008, *Organization of information about construction works — Framework for management of project information*

ISO 23386:2020, *Building information modelling and other digital processes used in construction — Methodology to describe, author and maintain properties in interconnected data dictionaries*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 29481-1 apply in addition to the following.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

IDM code

identifier for an IDM specification created based on the mandatory properties of an IDM specification

3.2

IDM specification

instance of an *IDM* and its components

3.3

use case

description of an information use with a specific purpose by one or more actors and by the system itself

[SOURCE: ISO 24014-1:2015, 2.30. Modified, the words “process as a sequence of actions performed” has been replaced with “an information use with a specific purpose”. The words “by defining” have been replaced with “as”.]

4 Overview of the IDM schema

4.1 Naming convention

The naming convention shown below is used for the IDM schema elements.

- a) All the characters in the first word shall be in lower case. From the second word, the first character shall be in upper case and the rest of the characters shall be in lowercase.
- b) Except for the terms below, all the terms shall be spelled out.
 - idm: information delivery manual
 - uc: use case
 - pm: process map
 - er: exchange requirement
 - im: interaction map
 - tm: transaction map
 - id: identifier
- c) The names of the elements that represent a group or a set shall be specified using a plural form such as *scopeKeywords*, *benefits*, and *localProjectPhases*.

4.2 Restriction notation

- PK: Primary Key
- The 1:1 restriction depicts that both the minimum and maximum occurrence of an element is 1. This means there shall be one element.
- The 0:1 restriction depicts that the minimum occurrence of an element is 0 and the maximum occurrence is 1.
- The 0:* restriction depicts the zero to many relationship, which is represented as minOccurs="0" to maxOccurs="unbounded" in the XML schema.

4.3 Overall structure of the IDM schema

The `idmXSD` consists of the IDM element, its three core components (i.e., UC, PM, and ER), and the relations and properties related to them.

- An IDM consists of a UC, PMs, and an ER.
- A UC shall include the header information specified in ISO 29481-1 and the other metadata to provide the context and the scope of an IDM.
- A PM visually and formally represents the information delivery processes for a use case. ISO 29481-1 recommends the exchange method and process to be specified using business process modelling notation (BPMN) models or using IMs and TMs.
- An ER defines the information required by a specific UC at an individual information-unit level possibly with references to the elements of standard information schemas such as cityGML, ISO 16739-1 (IFC), gbXML, or ISO 12006-3.

The following sections define the entities, relationships, attributes, and restrictions of the IDM schema. Figure 1 illustrates a conceptual view of the IDM schema. The full `idmXSD` is presented in Annex A.

5 Information Delivery Manual

The IDM element is a wrapper of IDM components—namely UCs, PMs, and ERs. The constraints between them are as follows:

- The IDM element shall be the single root element in the idmXSD.
- An IDM shall be associated with exactly one UC.
- An IDM may contain zero to many PMs and/or ERs.
- PM and ER components may be empty, to be detailed in a later revision.
- An IDM may include zero to many sub-IDMs. The other IDM components (i.e., UCs, PMs, and ERs) may also include zero to many sub-elements.

This structure allows all the IDM components to be associated with multiple IDMs, UCs, PMs, and ERs, which might have been specified by external groups.

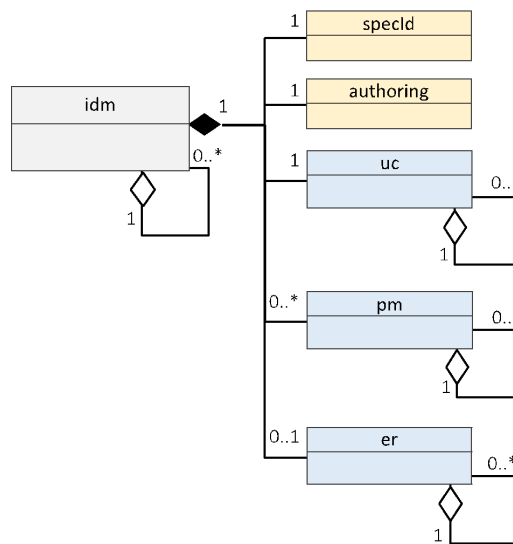


Figure 2 — A conceptual view of the IDM element

Table 1 lists the elements, types, and restrictions of the IDM element.

Table 1— The IDM's elements

Name	Type	Restriction	Description
specId	complexType	1:1	The specification identification information (see section 6 for the details)
authoring	complexType	1:1	The author and change log information (see section 7 for the details)
subIdm	element	0:*	A subset of an IDM.
uc	element	1:1	An associated UC
pm	element	0:*	Associated PMs
er	element	0:1	An associated ER

6 Specification Identifier (specId)

Each IDM component shall have a set of attributes associated with the identification of each element. An IDM specification and its sub-UC, PM, and ER specifications, shall use three types of identifiers: GUID, IDM code, and user-defined full and short titles (guid, idmCode, fullTitle, and shortTitle, respectively). These are referred to as the specId attribute group. The specId attribute group shall include the following:

specId
guid: String <<PK>>
shortTitle: String
fullTitle: String
subTitle: String
idmCode: String
localCode: String
documentStatus: String
localDocumentStatus: String
version: String

Figure 3 A logical view of the specId

Table 2. The Spec ID's attributes

Name	Type	Restriction	Description
guid	string	PK	A globally unique identifier (GUID).
shortTitle	string	optional	A running title or a nickname for an IDM specification; not machine-interpretable, not unique, optional
fullTitle	string	required	A full name of an IDM specification; not machine-interpretable, not unique, mandatory
subTitle	string	optional	A supplementary title for an IDM specification; not unique, optional
idmCode	string	required	A human-readable and machine-readable specification identifier generated according the IDM standard (see section 11 "IDM Code Generation Rules" for details)
localCode	string	optional	A legacy identifier or an IDM identifier generated according a local code generation rule
documentStatus	string	required	The status of an IDM specification from the initiation stage to the official release stage according to the ISO document release status classification specified in ISO/IEC Directives Part 1:2020.
localDocumentStatus	string	optional	The status of an IDM specification according to the local document release status
version	string	optional	A combination of numbers and/or strings, which signifies the evolution of an IDM specification

7 Authoring

The authoring element stores the author information and the change history of IDM specifications including the changed contents, the principal or organization who created and changed the contents, and the change date. The authoring is composed of changeLog, author, committee, and publisher.

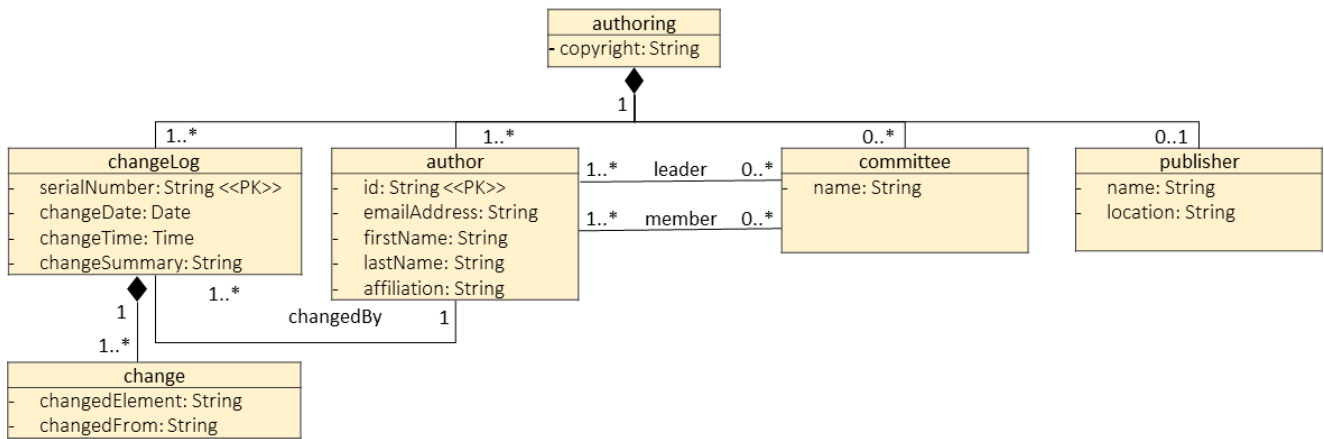


Figure 4. A logical view of the authoring attributes

Table 3. The Authoring's elements

Name	Type	Restriction	Description
copyright	string	required	A description about the copyright ownership and/or license information
changeLog	complexType	1:*	The history of a specification; a chronological list of who created and changed a specification and when the specification was created and changed (see section 7.1 for the details)
author	element	1:*	A person who creates or modifies a specification (see section 7.2 for the details)
committee	element	0:*	The author group of the IDM specification (see section 7.3 for the details)
publisher	element	0:1	The publisher of the IDM specification (see section 7.4 for the details)

7.1 ChangeLog

The changeLog consists of serialNumber, changeDate, changeTime, changeSummary (content), changedBy (the author who made a change), and change. The IDM user or developer can track the changes in the IDM specifications through the attributes in changeLog.

Table 4. The Change Log's attributes

Name	Type	Restriction	Description
------	------	-------------	-------------

serialNumber	string	PK	A unique identifier assigned incrementally or sequentially to an item to uniquely identify it
changeDate	date	required	The date when the changes were made. The format is defined by ISO 8601-1:2019.
changeTime	time	required	The time when the changes were made. The format is defined by ISO 8601-1:2019.
changeSummary	string	required	A description about the change summary made in a specification
changedBy	element	1:1	The author who created or made changes. A reference to an id of the author element. (See section 7.2 for the details.)
change	element	1:*	Each change in the changeLog

Table 5. The Change's attributes

Name	Type	Restriction	Description
changedElement	string	required	A metadata name that was changed.
changedFrom	string	required	A value before each element has changed

7.2 Author

The author element represents general information about the IDM user, such as emailAddress, name (firstName and lastName), affiliation, and id.

Table 6. The Author's attributes

Name	Type	Restriction	Description
id	string	PK	The unique identifier for representing each author.
emailAddress	string	required	The email address of an author as a unique identifier of the author
firstName	string	required	The first name of the author who creates or modifies a specification
lastName	string	required	The last name of the author who creates or modifies a specification
affiliation	string	optional	The affiliations of the author

7.3 Committee

The committee element shall be used when an IDM specification is developed as a committee effort or by a group of authors. The committee includes name, leader, member, etc.

Table 7. The Committee's attributes

Name	Type	Restriction	Description
name	string	PK	The name of an author group
leader	element	0..*	The author who leads an IDM specification author team. A reference to an authorId who belongs to a committee. Generally, the first author is the lead author. (See section 7.2 for the details.)
member	element	0..*	A reference to an authorId who belongs to a committee. (See section 7.2 for the details.)

7.4 Publisher

The publisher element represents the person or committee who published the IDM specification. It is composed of the name and location.

Table 8. The Publisher's attributes

Name	Type	Restriction	Description
name	string	required	The title who published the IDM specification
location	string	optional	The region where the IDM specification was published. It can be a country or a city

8 Use Case

Figure 5 illustrates the relationship between UC, PM, and ER in ISO 29481 Parts 1 and 3. The UC element can be understood as a collection or an extension of the *overview* information of a PM and an ER specified in ISO 29481 Part 1 and the specID and authoring elements as a collection or an extension of the *header* information in ISO 29481 Part 1.

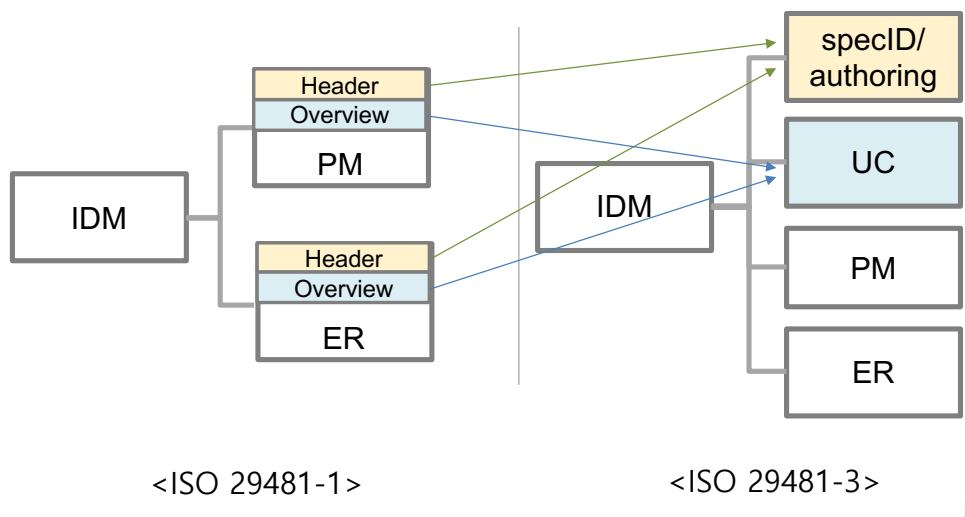


Figure 5 The relationship between UC, PM, and ER in ISO 29481 Parts 1 and 3

The UC element includes the header information of the IDM specifications, which is the general information on the IDM use case: specId, authoring, language, useGroup, use, summary, aimAndScope, region, isoProjectPhase, localProjectPhaseClassification, businessRule, constructionEntityClassification, actorClassification, benefits, scopeKeywords, benefitKeywords, limitations, basisStandards, references, requiredResources, requiredCompetencies and notes.

A UC element may be composed of zero to many subUcs.

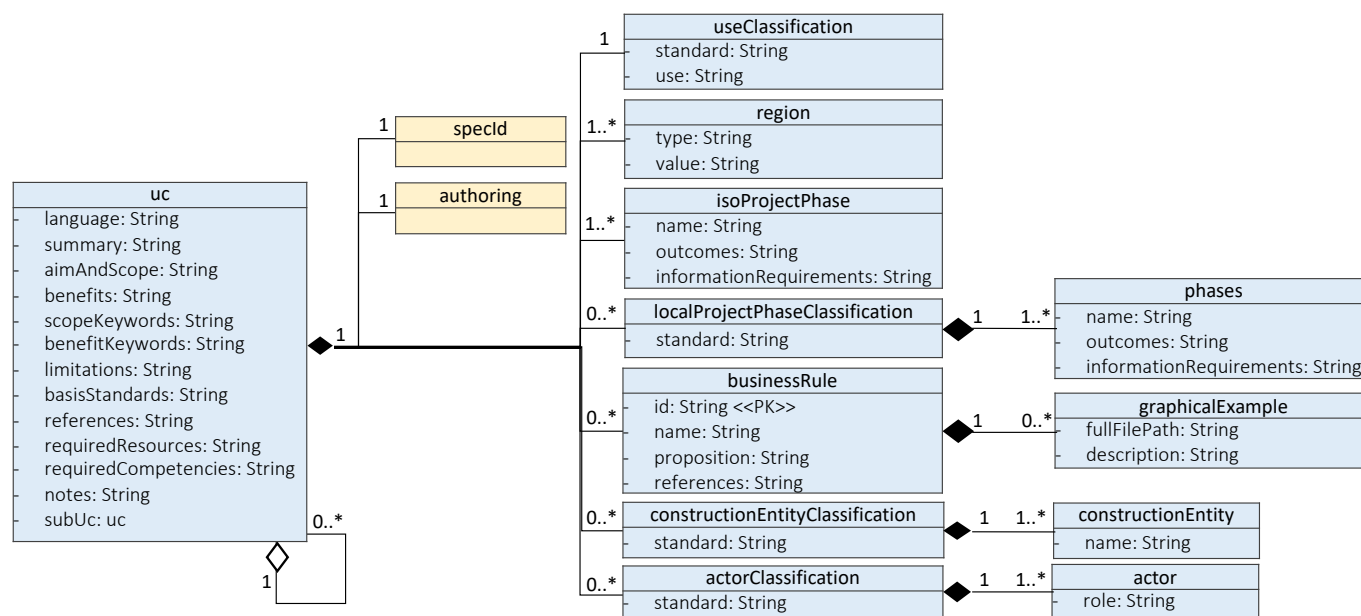


Figure 6 A logical view of the UC element

Table 9. The Use Case's attributes

Name	Type	Restriction	Description
specId	complexType	1:1	The specification identification information (see section 6 for the details)
authoring	complexType	1:1	The author and changeLog information (see section 7 for the details)
subUc	element	0:*	A subset of a UC, which provides detailed view of the UC
language	string	required	The language used to define a specification based on ISO 639-1:2002 (see section 8.5 for the details)
summary	string	required	A brief “description” or an “overview” of the aim and scope, benefits, target phases, use cases, and other aspects of an IDM specification

aimAndScope	string	required	The purpose and coverage of an IDM
useClassification	element	1:1	A classification system for information uses preferred by a specific country or an organization (see section 8.1 for the details)
region	element	1:*	A geographical area where a specified document will be used (see section 8.4 for details)
isoProjectPhase	element	1:*	The stage of a project that a specification is targeting based on ISO 22263:2008 (see section 8.2 for the details)
localProjectPhaseClassification	complexType	0:*	An alternative project lifecycle classification chosen by the authors (e.g., GPP, AIA, RIBA). This is optional. (See section 8.3 for the details.)
businessRule	element	0:*	Operation, definition, or constraint that can be applied to a set of data used within a particular process or activity (see section 8.8 for the details)
constructionEntityClassification	complexType	0..*	A type of construction product by function (see section 8.7 for the details)
actorClassification	complexType	0:*	The role or discipline of the project participant who is sending and receiving information (see section 8.6 for the details)
benefits	string	optional	Advantages that can be gained from a use case
scopeKeywords	string	optional	A list of the keywords that represent the scope of a use case
benefitKeywords	string	optional	A list of the keywords that represent the advantages that can be gained from a specified use case
limitations	string	optional	A list of the weaknesses, limited scopes, or distinctive characteristics of a use case

basisStandards	string	optional	A list of the standards that a use case is based on
references	string	optional	A list of the publications that a use case refers to
requiredResources	string	optional	A list of entities that are prerequisites to begin a use case
requiredCompetencies	string	optional	A list of the competencies required by a team member to conduct the jobs specified in a use case
notes	string	optional	Other comments or notes

8.1 Use Classification

The useClassification of the IDM is a high-level classification of information uses in construction. The classification system is specified by the use classification standard attribute. The use attribute describes a specific use of information.

Table 10. The Use Classification's attributes

Name	Type	Restriction	Description
standard	string	optional	The name of the standard classification system for information uses preferred by a specific country or an organization; optional
use	string	required	A method of utilizing information in a project for a specific purpose

8.2 ISO Project Phase

The isoProjectPhase's attributes represent the project targeting phases of the IDM specifications. In particular, the ISO project phase, which follows ISO 22263, shall be defined for the design coordination or cooperation between international companies or institutions. ISO 22263 classifies a project lifecycle into six phases: inception, brief, design, production, maintenance, and demolition. An IDM can target one or more phases.

Table 11. The ISO Project Phase's attributes

Name	Type	Restriction	Description
name	element	required	The name of the targeted ISO project stage
outcomes	string	optional	The descriptions of the expected results when the selected project phase is finished

informationRequirements	string	optional	The descriptions of the information requirements when the selected local project phase is finished
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8.3 Local Project Phase Classification

The authors can additionally define a target project phase based on a project-phase classification of their choice. This is referred to as the localProjectPhase Classification. To specify a localProjectPhase, the first step is to specify the standard project-phase classification system that the authors prefer to use, such as a project classification system by Green Public Procurement (GPP), the American Institute of Architects (AIA), or the Royal Institute of British Architects (RIBA) in the localProjectClassificationStandard attribute. The second step is to specify the target phases of an IDM in the localProjectPhase element.

Table 12. The Local Project Phase Classification's attributes

Name	Type	Restriction	Description
standard	string	required	A classification system for the construction project phases preferred by a specific country or an organization. The use of a local project phase is optional, but if it is used, the local project phase classification shall be specified.
phases	element	1:*	A stage of a project in which the targeted specification is based on the chosen classification standard

Table 13. The Local Project Phase's attribute

Name	Type	Restriction	Description
name	string	required	A stage name for the construction project phases preferred by a specific country or organization
outcomes	string	optional	The descriptions of the expected results when the specified local project phase is finished
informationRequirements	string	optional	The descriptions of the information requirements when the specified local project phase is finished

8.4 Region

The region element specifies the target regions of an IDM.

Table 14. The Region's attributes

Name	Type	Restriction	Description
type	string	required	A geographical area where a specified document will be used. The region type is the continent, country, or user-defined region. The default value is the "user-defined region."
value	string	required	A target region of an IDM. The default value is "INT," which stands for international (use). For specific continents or countries, the continent and country codes defined in ISO 3166-1:2020 shall be used.

8.5 Language

The language used to specify an IDM shall be specified according to ISO 639-1. ISO 639-1 provides a two-letter code for the major languages of the world.

8.6 Actor Classification

The actor classification element specifies the actors who send and receive the required information (i.e., ER). More than one actor can send and receive an ER. Users can choose a standard classification for the actor (role) type. The standard attribute allows users to specify the actor classification standard of their choice.

Two examples of such standards are Omniclass 33 Discipline and Omniclass 34 Organizational Roles.

Table 15. The Actor Classification's attributes

Name	Type	Restriction	Description
standard	string	required	A classification system for the actors preferred by a specific country or an organization
actor	element	1:*	A person, organization or organizational unit (such as a department, team, etc.) involved in a construction process [SOURCE: ISO 29481-1:2016, 3.1]

Table 16. The Actor's attributes

Name	Type	Restriction	Description
------	------	-------------	-------------

role	string	required	A role name in a project, such as client, architect, or contractor
-------------	--------	----------	--

8.7 Construction Entity Classification

The `constructionEntityClassification` element specifies the project type that an IDM specification aims to support. Some examples are a hospital facility, an airport, a railway, and a data center. The standard attribute is the field to define a standard classification system for construction entities.

An example of the standard classification system is OmniClass Table 11— Construction Entities by Function.

Table 17. The Construction Entity Classification's attributes

Name	Type	Restriction	Description
standard	string	required	A classification system for construction entities preferred by a specific country or an organization
constructionEntity	element	1:*	A construction entity of a project in which the targeted specification is based on the chosen classification standard

Table 18. The Construction Entity's attributes

Name	Type	Restriction	Description
name	string	required	A construction entity name of a project in which the targeted specification is based on the chosen classification standard

8.8 Business Rule

The `businessRule` element describes the operations, definitions and constraints that can be applied to the set of data used within a particular process or activity. A business rule is composed of id, name, and proposition.

Table 19. The Business Rule's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for a business rule at least within a specification (e.g., NBS-Rule-6001)
name	string	required	A user-defined short title for a business rule, not unique (e.g., Aggregate Electric Elements to a Distribution Point)
proposition	string	required	A description of the rule (e.g., only occurrences of particular types of

			electrical distribution elements can be aggregated within a distribution point)
reference	string	0:*	
graphicalExample	element	0:*	A graphical specification of an information unit's example

Table 20. The Business Rule Graphical Example's attributes

Name	Type	Restriction	Description
fullFilePath	string	required	A link (e.g., a universal resource locator) to an image file that depicts an example of a business rule
description	string	optional	A name or description of an image depicting an example of a business rule

9 Process Map

A PM graphically represents how and when information is exchanged by whom, optionally with textual descriptions. ISO 29481-1 recommends BPMN as the default PM notation. As such, a PM diagram specified in the BPMN 2.0 XML format is preferred. Alternatively, a PM diagram can be specified using the IM/TM notation.

A PM may include zero to many sub-PMs. Sub-PMs include detailed views of a PM while the sub-elements of the other IDM components form subsets of the other IDM components.

The pm element includes specId, authoring, associatedPmDiagram, and associatedImDiagram.

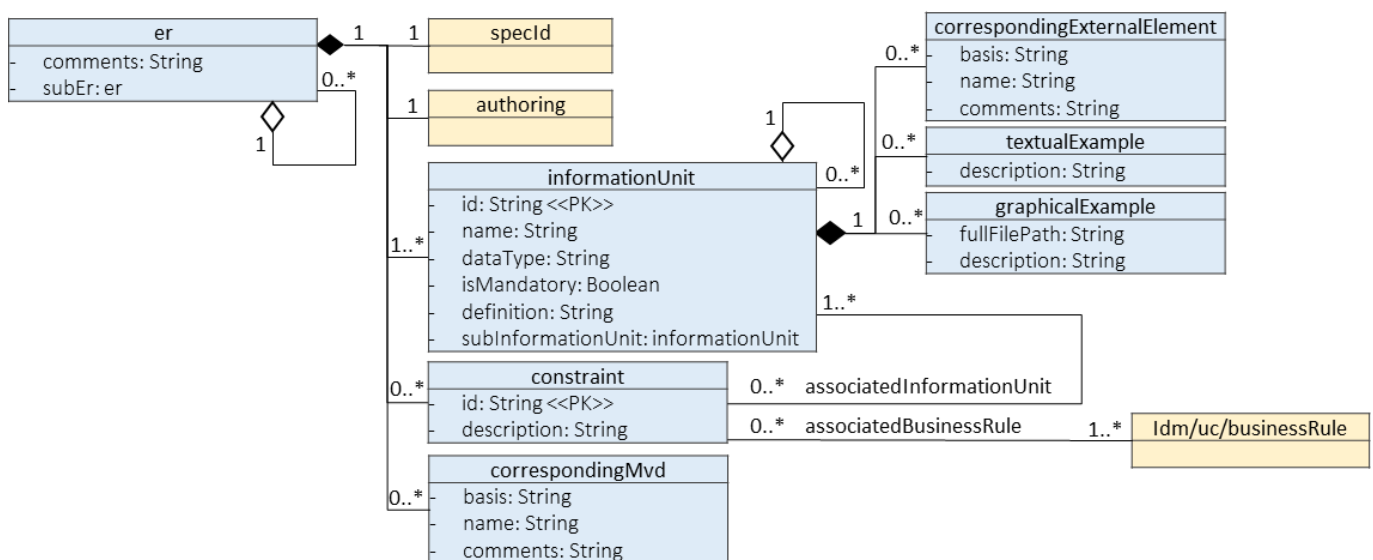


Figure 7 A logical view of the process map element

Table 21. The Process Map's elements

Name	Type	Restriction	Description
specId	complexType	1:1	The specification identification information (see section 6 for the details)
authoring	complexType	1:1	The author and hangelog information (see section 7 for the details)
subPm	element	0:*	A subset of a PM, which provides detailed view of the PM
associatedPmDiagram	complexType	1:*	An associated PM diagram (see section 9.1 for the details)
associatedImDiagram	complexType	0:*	An associated interaction map model diagram (see section 9.2 for the details)

9.1 Associated PM Diagram

The associatedPmDiagram element links a PM diagram file to a PM with name, data object, and activity business rule elements. The associatedPmDiagram element is composed of id, name, fileName, description, pmElement, pmRelation, dataObjectAndEr, and activityAndBusinessRule.

Table 22. The Associated PM Diagram's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for a PM diagram
name	string	required	A title for a PM diagram
fileName	string	required	A file name of a PM diagram
description	string	optional	A comment or description of a PM diagram
pmElement	complexType	0..*	An element in a PM diagram and basic information about it (see section 9.1.1 for the details)
pmRelation	element	0..*	A relation element in a PM diagram between the pm elements (see section 9.1.2 for the details)
dataObjectAndEr	element	1:*	The mapping relationship between a data object in a PM diagram and an ER (see section 9.1.3 for the details)
activityAndBusinessRule	element	0:*	The mapping relationship between an activity in the PM diagram and the business rule of the use case (see section 9.1.4 for the details)

9.1.1 PM Element

The pmElement element shall be used to specify an element in a PM diagram. It is composed of id, type, name, userDefinedId, description, sender, and receiver.

Table 23. The pmElement's attributes

Name	Type	Restriction	Description
id	string	PK	A unique BPMN identifier for a PM element
type	string	required	A type of a PM element (e.g., task, decision point, data object)
name	string	required	A name of a PM element; not unique; mandatory
userDefinedId	string	optional	A user-defined identifier for a PM element; optional; unique within a PM diagram
description	string	optional	A comment or description about a PM element
sender	element	0..*	A pm element's sender referenced to the actor element of the uc (see section 8.6 for the details on the actor element)
receiver	element	0..*	A pm element's receiver referenced to the actor element of the uc (see section 8.6 for the details on the actor element)

9.1.2 PM Relation

The pmRelation element shall be used to specify the PM relationships that connect the pm elements in a PM diagram. It is composed of id, connectedTo, and connectedFrom.

Table 24. The PM Relation's attributes

Name	Type	Restriction	Description
id	string	PK	A unique BPMN identifier for a PM relation element
connectedTo	element	1:1	A reference to the target PM element bpmnId (see section 9.1.1 for the details on the PM element)
connectedFrom	element	1:1	A reference to the source PM element bpmnId (see section 9.1.1 for details on the PM element)

9.1.3 Data Object And ER

The dataObjectAndEr element links a data object in a PM diagram with its associated ERs. It shall be composed of ofid, associatedDataObject, associatedEr, and description.

Table 25. The Data Object And ER's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for the mapping relationship between a data object and an ER
associatedDataObject	element	1..*	A reference to the associated data object bpmnId of pmElement (see section 9.1.1 for the details on the PM element)
associatedEr	element	1..*	A reference to the associated ER guid of ER's specId (see section 10 for the details on the ER element)
description	string	optional	A comment or a description about a data object and an associated ER

9.1.4 Activity And Business Rule

The activityAndBusinessRule element connects activities and associated business rules. The activityAndBusinessRule element shall be composed of id, associatedActivity, and associatedBusinessRule. The associatedBusinessRule links an activity in a PM with the business rule of a use case.

Table 26. The Activity And Business Rule's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for the mapping relationship between an activity and a business rule
associatedActivity	element	1..*	A reference to the associated activity bpmnId of pmElement (see section 9.1.1 for the details on the PM element)
associatedBusinessRule	element	1..*	A reference to the associated business rule's businessRuleId of the UC's businessRule (see section 8.8 for the details on the Business Rule element)

9.2 Associated IM Diagram

An IM shall graphically represent an information-exchange process, optionally with textual descriptions focusing on the information transactions between actors (roles) whereas a PM focuses on the information exchange between activities.

An IM shall be composed of zero to many TMs to provide detailed views of an IM.

Table 27. The Associated IM Diagram's attributes

Name	Type	Restriction	Description
------	------	-------------	-------------

id	string	PK	A unique identifier for an IM diagram
name	string	required	A title for an IM diagram
fileName	string	required	A file name of an IM diagram
description	string	optional	A comment or description of an IM diagram
associatedTmDiagram	element	0:*	An associated TM diagram (see section 9.2.1 for the details)

9.2.1 Associated TM Diagram

A TM is a subcomponent of an IM and an elaborated description of the information transactions between actors.

Table 28. The Associated TM Diagram's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for a TM diagram
name	string	required	A title for a TM diagram
fileName	string	required	A file name of a TM diagram
description	string	Optional	A comment or description of an TM diagram

10 Exchange Requirement

An ER is composed of a list of specific information units and/or sub-ERs.

An ER also includes the identification information (specId), the authoring information (authoring), the constraints, and the optional links to the external schema elements and/or to a corresponding MVD.

An ER shall not be empty and shall have at least one information unit or a sub-ER.

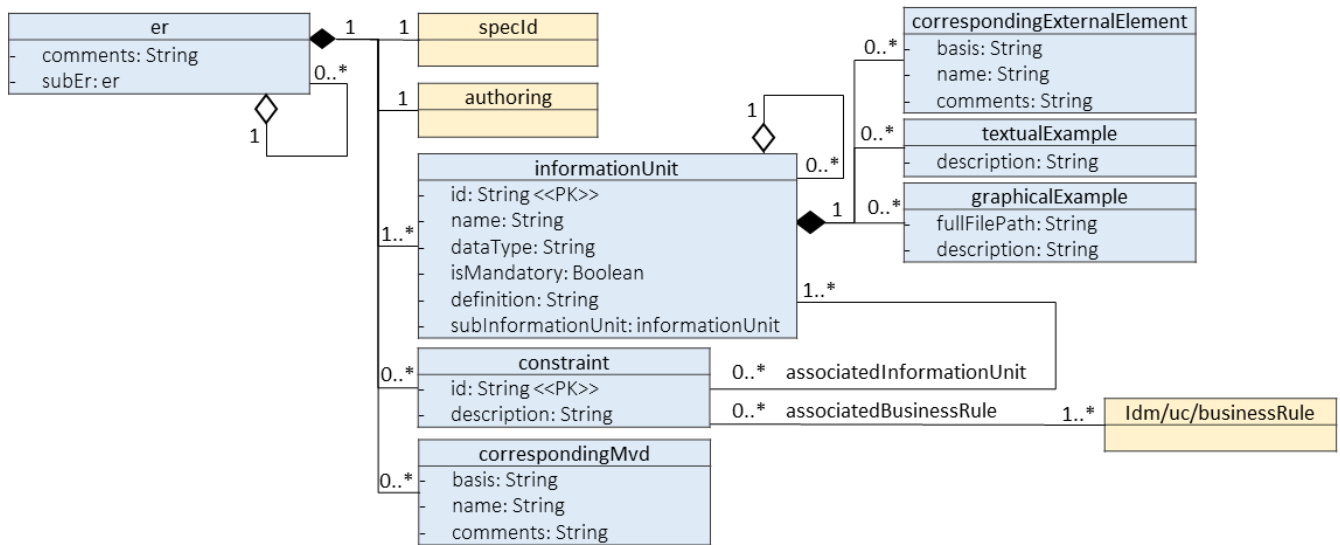


Figure 8 A logical view of the ER element

Table 29. The Exchange Requirement's attributes

Name	Type	Restriction	Description
specId	complexType	1:1	The specification identification information (see section 6 for the details)
authoring	complexType	1:1	The author and changeLog information (see section 7 for the details)
subEr	element	0:*	A subset of an ER, which provides detailed view of the ER
comments	string	optional	Comments or notes on an ER
informationUnit	complexType	1:*	Specific piece of information required by a use case (see section 10.1 for the details)
constraint	complexType	0:*	The constraint that an ER needs to meet (see section 10.2 for the details)
correspondingMvd	element	0:*	An optional link to the MVDs associated with an ER (see section 10.3 for the details)

10.1 Information Unit

The informationUnit element includes id, name, dataType, isMandatory, definition, subInformationUnit, correspondingExternalElement, textualExample, and graphicalExample.

- The subInformationUnit element permits an information unit to be recursively specified as a collection of information units.

- Optionally, an information unit can be referenced to a specific element in an open standard schema or to a term(s) in a standard data dictionary via correspondingExternalElement.
- Textual or graphical examples may be provided via textualExample or graphicalExample.

Table 30. The Information Unit's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for an information unit
name	string	required	A name of the information unit
dataType	string	required	A data type with which the information unit is exchanged
isMandatory	boolean	required	An attribute that indicates whether an information unit is mandatorily or optionally required. True signifies mandatory. False signifies optional.
definition	string	required	A description of an information unit
subInformationUnit	complexType	0:*	A collection of one or more information units, which forms a higher-level information unit. A reference key to the sub-informationUnitId of the ER's informationUnit.
correspondingExternalElement	element	0:*	The mapping relation between an external element in an open standard data schema and a corresponding information unit (e.g., mapping between an information unit <i>project</i> and a corresponding IFC element <i>ifcProject</i>) (see Table 30 for details)
textualExample	element	0:*	A textual description of an information unit's example
graphicalExample	element	0:*	A graphical specification of an information unit's example

Table 31. The Corresponding External Element's attributes

Name	Type	Restriction	Description
basis	string	required	A basis schema or reference for the external element corresponding to an information unit. Some examples are IFC 4.0, CityGML, and ISO 12006-3.
name	string	required	The name of the external element corresponding to an information unit

comments	string	optional	Notes for the external element
----------	--------	----------	--------------------------------

Table 32. The Textual Example's attributes

Name	Type	Restriction	Description
description	string	required	A textual description of an example of an information unit

Table 33. The Graphical Example's attributes

Name	Type	Restriction	Description
fullFilePath	string	required	A link (e.g., a universal resource locator) to an image file that depicts an example of an information unit
description	string	optional	A name or description of an image depicting an example of an information unit

10.2 Constraint

The constraint element is composed of the id, description, associatedInformationUnit, and associatedBusinessRule.

- The information units associated with a constraint are specified via associatedInformationUnit.
- A constraint may be associated with zero to many business rules of a use case via associatedBusinessRule.

Table 34. The Constraint's attributes

Name	Type	Restriction	Description
id	string	PK	A unique identifier for a constraint
description	string	required	A description that the constraint indicates
associatedInformationUnit	element	1:*	A reference to the information unit element associated with a constraint; referred to as informationUnitId of the informationUnit (see section 10.1 for the details)

associatedBusinessRule	element	1:*	A reference to the business rule associated with a constraint; referred to as a businessRuleId of the UC's businessRule (see section 8.8 for the details)
------------------------	---------	-----	---

10.3 Corresponding MVD

MVDs shall be specified externally and shall not be the scope of the IDM. However, optionally, an MVD associated with an ER can be notified using the correspondingMvd. Some examples of an MVD are Coordination View 1.3 and Coordination View 2.0, or subsets of open standard schemas such as IFC 4.0, CityGML, and ISO 12006-3.

The correspondingMvd consists of the basis, name, and comments.

Table 35. The Corresponding MVD's attributes

Name	Type	Restriction	Description
basis	string	required	A basis schema or reference for the MVD that corresponds to an ER. Some examples are IFC 4.0, CityGML, and ISO 12006-3.
name	string	required	The name of the MVD that corresponds to an ER, such as Coordination View 1.3 and Coordination View 2.0
comments	string	optional	Notes for the corresponding MVD

11 IDM Code Generation Rules

An IDM code is a human-interpretable code. By having a human-interpretable code, unlike the purely machine-interpretable identifiers such as a GUID or a freely defined name, users shall be able to identify the main content of an IDM specification only by looking at the code.

An IDM code is composed of two parts: an IDM classification code and a documented-oriented information code. The core attributes are the mandatory attributes with a high frequency of use in the existing IDM specifications, namely specification type, primary use, primary project phase, primary region, and language. To provide additional “document-oriented” information, it uses three more attributes: author/committee, initial date, and release.

Figure 9 shows an example of an IDM code. Table 35 describes the definition, example, and associated standard of the additional document-oriented attributes.

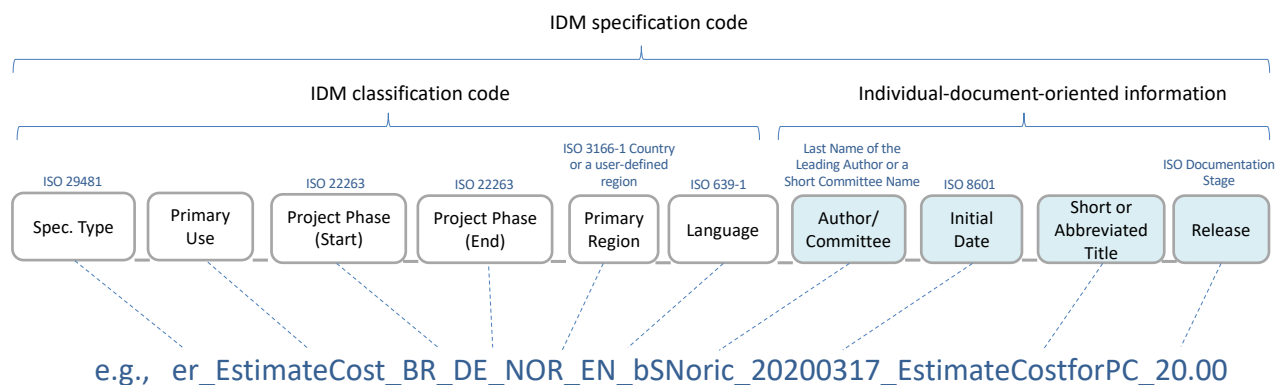


Figure 9. The IDM Code

Table 36. The IDM Code Items

Name	Definition	Examples	Associated standard
Spec. type	An initial of IDM specification types	er, uc, pm, im	ISO 29481-1
Primary use	The primary use of an IDM specification defined in the form of a verb plus a noun	coordinate_design manage_facility	ISO 29481-1
Primary project phase (start and end)	The primary project phase that an IDM specification is targeting based on ISO 22263:2008.	Inception (IN) Brief (BR) Design (DE) Production (PR) Maintenance (MA) Demolition (DE)	ISO 22263
Primary region	A country where an IDM specification is primarily used based on ISO 3166-1. Optionally, the use of a user-defined region such as "French-speaking chapter" shall be allowed. A user-defined region shall use the abbreviation "USR".	Aruba (ABW) Afghanistan (AFG) Angola (AHO) Anguilla (AIA)	ISO 3166-1
Language	The language of an IDM specification based on ISO 639-1	Chinese (CN) English (EN) French (FR) Korean (KR)	ISO 639-1
Author/committee	The last name of a leading author or a short name for a committee	Smith bSI	
Short or abbreviated title	A short title or an abbreviated title	PC Cost Estimate	
Initial date	The date when the first draft of an IDM specification was released based on ISO 8601	YYYYMMDD 20200317	ISO 8601
isoStatus	The stage of a document based on ISO/IEC Directives Part 1		ISO/IEC Directives Part 1 Documentation Stage

Annex A (informative)

The idmXML Schema Definition (idmXSD)

A.1 idm.xsd

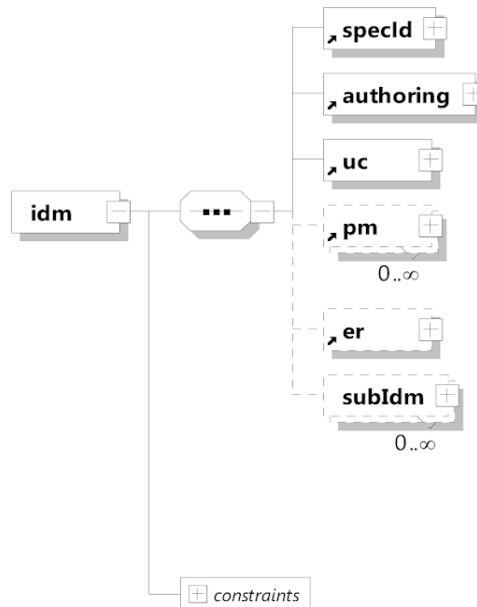


Figure A. 1 – idm.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:idm="https://standards.buildingsmart.org/IDM/idmXML/0.2"
  xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="specId.xsd"/>
  <xs:include schemaLocation="authoring.xsd"/>
  <xs:include schemaLocation="uc.xsd"/>
  <xs:include schemaLocation="pm.xsd"/>
  <xs:include schemaLocation="er.xsd"/>
  <xs:element name="idm">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="specId"/>
        <xs:element ref="authoring"/>
        <xs:element ref="uc"/>
        <xs:element ref="pm" minOccurs="0" maxOccurs="unbounded"/>
        <xs:element ref="er" minOccurs="0" maxOccurs="1"/>
        <xs:element name="subIdm" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="idm"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:key name="key_idm_guid">
      <xs:selector xpath="./specId"/>
      <xs:field xpath="@guid"/>
    </xs:key>
  </xs:element>
</xs:schema>

```


A.2 uc.xsd

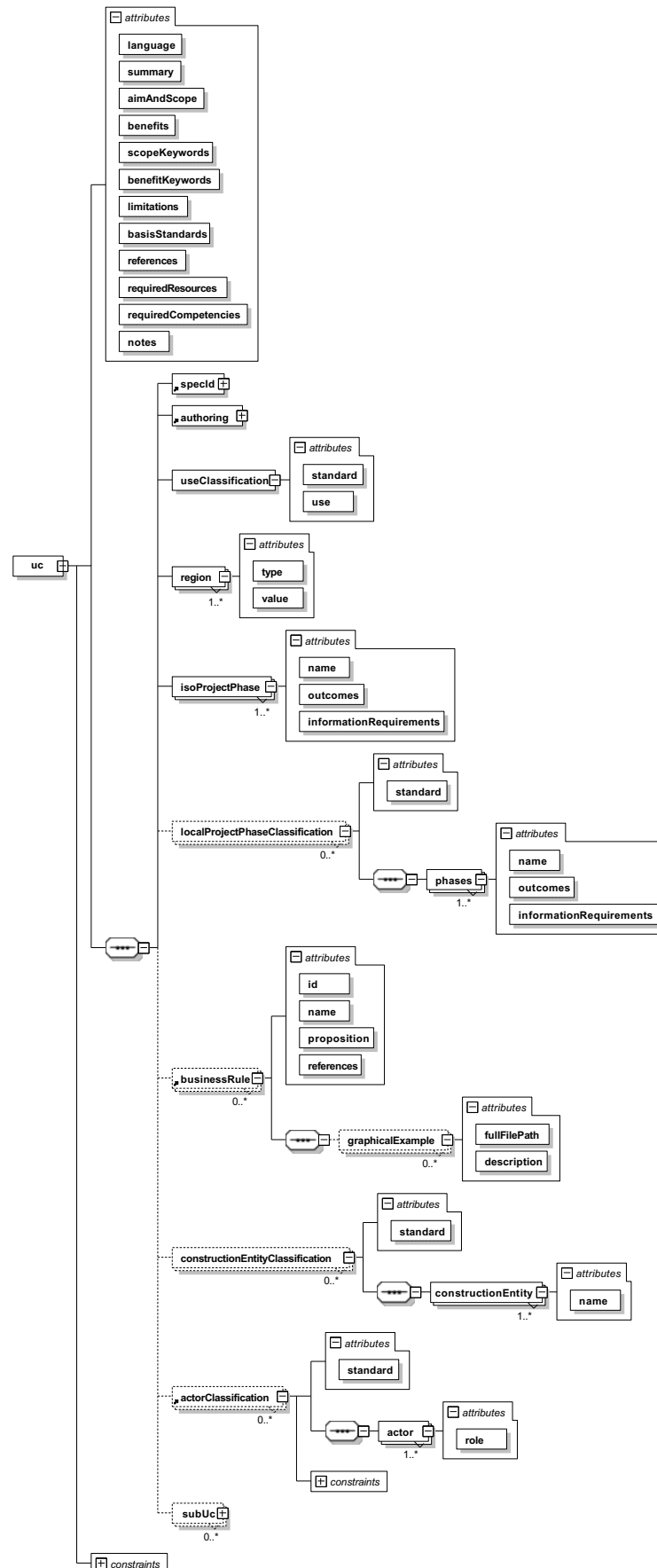


Figure A. 2 - uc.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:ids="https://standards.buildingsmart.org/IDM/idsXML/0.2"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="specId.xsd"/>
  <xs:include schemaLocation="authoring.xsd"/>
  <xs:element name="uc">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="specId"/>
        <xs:element ref="authoring"/>
        <xs:element name="useClassification" minOccurs="1" maxOccurs="1">
          <xs:complexType>
            <xs:attribute name="standard" type="xs:string" use="optional"/>
            <xs:attribute name="use" type="xs:string" use="required"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="region" maxOccurs="unbounded">
          <xs:complexType>
            <xs:attribute name="type" type="xs:string" use="required"/>
            <xs:attribute name="value" type="xs:string" use="required"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="isoProjectPhase" minOccurs="1" maxOccurs="unbounded">
          <xs:complexType>
            <xs:attribute name="name" type="xs:string" use="required"/>
            <xs:attribute name="outcomes" type="xs:string" use="optional"/>
            <xs:attribute name="informationRequirements" type="xs:string" use="optional"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="localProjectPhaseClassification" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="phases" minOccurs="1" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="name" type="xs:string" use="required"/>
                  <xs:attribute name="outcomes" type="xs:string" use="optional"/>
                  <xs:attribute name="informationRequirements" type="xs:string"
use="optional"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="standard" use="required"/>
          </xs:complexType>
        </xs:element>
        <xs:element ref="businessRule" minOccurs="0" maxOccurs="unbounded"/>
        <xs:element name="constructionEntityClassification" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="constructionEntity" minOccurs="1" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="name" type="xs:string" use="required"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="standard" type="xs:string"/>
          </xs:complexType>
        </xs:element>
        <xs:element ref="actorClassification" minOccurs="0" maxOccurs="unbounded"/>
        <xs:element name="subUc" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="uc"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
      <xs:attribute name="language" type="xs:string" use="required"/>
    </xs:complexType>
  </xs:element>

```

```

        <xs:attribute name="summary" type="xs:string" use="required"/>
        <xs:attribute name="aimAndScope" type="xs:string" use="required"/>
        <xs:attribute name="benefits" type="xs:string" use="optional"/>
        <xs:attribute name="scopeKeywords" type="xs:string" use="optional"/>
        <xs:attribute name="benefitKeywords" type="xs:string" use="optional"/>
        <xs:attribute name="limitations" type="xs:string" use="optional"/>
        <xs:attribute name="basisStandards" type="xs:string" use="optional"/>
        <xs:attribute name="references" type="xs:string" use="optional"/>
        <xs:attribute name="requiredResources" type="xs:string"/>
        <xs:attribute name="requiredCompetencies" type="xs:string"/>
        <xs:attribute name="notes"/>
    </xs:complexType>
    <xs:key name="key_uc_guid">
        <xs:selector xpath="specId"/>
        <xs:field xpath="@guid"/>
    </xs:key>
    <xs:key name="key_businessRuleId">
        <xs:selector xpath="idm/uc/businessRule"/>
        <xs:field xpath="@businessRuleId"/>
    </xs:key>
    <xs:key name="key_uc_role">
        <xs:selector xpath="idm/uc/actorClassification/actor"/>
        <xs:field xpath="@role"></xs:field>
    </xs:key>
</xs:element>
<xs:element name="actorClassification">
    <xs:complexType>
        <xs:sequence>
            <xs:element name="actor" minOccurs="1" maxOccurs="unbounded">
                <xs:complexType>
                    <xs:attribute name="role" type="xs:string" use="required"/>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
        <xs:attribute name="standard" type="xs:string"/>
    </xs:complexType>
    <xs:key name="key_actorRole">
        <xs:selector xpath="./uc/actorClassification/actor"/>
        <xs:field xpath="@role"/>
    </xs:key>
</xs:element>
<xs:element name="businessRule">
    <xs:complexType>
        <xs:sequence>
            <xs:element name="graphicalExample" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                    <xs:attribute name="fullFilePath" type="xs:string" use="required"/>
                    <xs:attribute name="description" type="xs:string" use="optional"/>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
        <xs:attribute name="id" type="xs:string" use="required"/>
        <xs:attribute name="name" type="xs:string" use="required"/>
        <xs:attribute name="proposition" type="xs:string" use="required"/>
        <xs:attribute name="references" type="xs:string" use="optional"/>
    </xs:complexType>
</xs:element>
</xs:schema>

```

A.3 pm.xsd

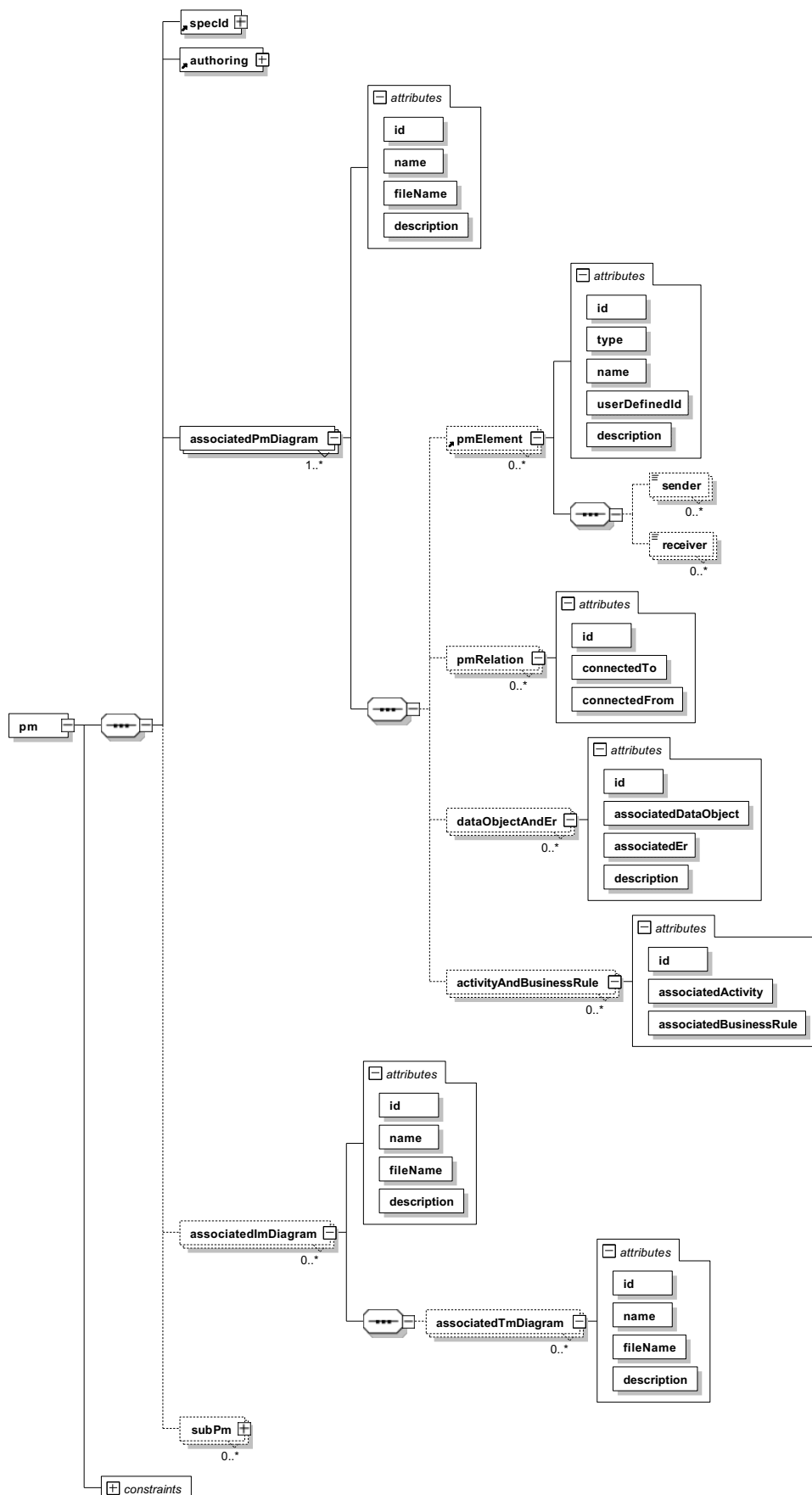


Figure A. 3 - pm.xsd


```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="specId.xsd"/>
  <xs:include schemaLocation="authoring.xsd"/>
  <xs:include schemaLocation="uc.xsd"/>
  <xs:include schemaLocation="er.xsd"/>
  <xs:attribute name="attribute-name" type="xs:string" default="string-value"/>
  <xs:element name="pm">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="specId"/>
        <xs:element ref="authoring"/>
        <xs:element name="associatedPmDiagram" minOccurs="1" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="pmElement" minOccurs="0" maxOccurs="unbounded"/>
              <xs:element name="pmRelation" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="id" use="required"/>
                  <xs:attribute name="connectedTo" use="required"/>
                  <xs:attribute name="connectedFrom" use="required"/>
                </xs:complexType>
              </xs:element>
              <xs:element name="dataObjectAndEr" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" use="required"/>
                  <xs:attribute name="associatedDataObject" type="xs:NCName"
use="required"/>
                  <xs:attribute name="associatedEr" type="xs:NCName" use="optional"/>
                  <xs:attribute name="description" type="xs:string" use="optional"/>
                </xs:complexType>
              </xs:element>
              <xs:element name="activityAndBusinessRule" minOccurs="0"
maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" use="required"/>
                  <xs:attribute name="associatedActivity" type="xs:NCName"
use="required"/>
                  <xs:attribute name="associatedBusinessRule" type="xs:NCName"
use="required"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="id" type="xs:string" use="required"/>
            <xs:attribute name="name" type="xs:string" use="required"/>
            <xs:attribute name="fileName" type="xs:string" use="required"/>
            <xs:attribute name="description" type="xs:string" use="optional"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="associatedImDiagram" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="associatedTmDiagram" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" use="required"/>
                  <xs:attribute name="name" type="xs:string" use="required"/>
                  <xs:attribute name="fileName" type="xs:string" use="required"/>
                  <xs:attribute name="description" type="xs:string" use="required"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="id" type="xs:string" use="required"/>
            <xs:attribute name="name" type="xs:string" use="required"/>
            <xs:attribute name="fileName" type="xs:string" use="required"/>
            <xs:attribute name="description" type="xs:string" use="optional"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

```



```

        <xs:element name="subPm" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
                <xs:sequence>
                    <xs:element ref="pm"/>
                </xs:sequence>
            </xs:complexType>
        </xs:element>
    </xs:sequence>
</xs:complexType>
<xs:key name="key_pm_guid">
    <xs:selector xpath="./pm/specId"/>
    <xs:field xpath="@guid"/>
</xs:key>
<xs:key name="key_pmDiagramId">
    <xs:selector xpath="./pm/associatedPmDiagram"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_pmElement_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/pmElement"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_pmRelation_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/pmRelation"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_dataObjectAndErId">
    <xs:selector xpath="./pm/associatedPmDiagram/dataObjectAndEr"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_activityBusinessRuleId">
    <xs:selector xpath="./pm/associatedPmDiagram/activityAndBusinessRule"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_associatedImDiagram">
    <xs:selector xpath="./pm/associatedImDiagram"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:key name="key_associatedTmDiagram">
    <xs:selector xpath="./pm/associatedImDiagram/associatedTmDiagram"/>
    <xs:field xpath="@id"/>
</xs:key>
<xs:keyref name="keyref_pmElement_sender" refer="key_uc_role">
    <xs:selector xpath="./pm/associatedPmDiagram/pmElement"/>
    <xs:field xpath="sender"/>
</xs:keyref>
<xs:keyref name="keyref_pmElement_receiver" refer="key_uc_role">
    <xs:selector xpath="./pm/associatedPmDiagram/pmElement"/>
    <xs:field xpath="receiver"/>
</xs:keyref>
<xs:keyref name="keyref_connectedTo" refer="key_pmElement_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/pmRelation"/>
    <xs:field xpath="@connectedTo"/>
</xs:keyref>
<xs:keyref name="keyref_connectedFrom" refer="key_pmElement_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/pmRelation"/>
    <xs:field xpath="@connectedFrom"/>
</xs:keyref>
<xs:keyref name="keyref_associatedDataObject" refer="key_pmElement_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/dataObjectAndEr"/>
    <xs:field xpath="@associatedDataObject"/>
</xs:keyref>
<xs:keyref name="keyref_associatedEr" refer="key_er_guid">
    <xs:selector xpath="./pm/associatedPmDiagram/dataObjectAndEr"/>
    <xs:field xpath="@associatedEr"/>
</xs:keyref>
<xs:keyref name="keyref_associatedActivity" refer="key_pmElement_bpmnId">
    <xs:selector xpath="./pm/associatedPmDiagram/activityAndBusinessRule"/>

```

```

        <xs:field xpath="@associatedActivity"/>
    </xs:keyref>
    <xs:keyref name="keyref_associatedBusinessRule" refer="key_businessRuleId">
        <xs:selector xpath="./pm/associatedPmDiagram/activityAndBusinessRule"/>
        <xs:field xpath="@associatedBusinessRule"/>
    </xs:keyref>
</xs:element>
<xs:element name="pmElement">
    <xs:complexType>
        <xs:sequence>
            <xs:element name="sender" minOccurs="0" maxOccurs="unbounded"/>
            <xs:element name="receiver" minOccurs="0" maxOccurs="unbounded"/>
        </xs:sequence>
        <xs:attribute name="id" type="xs:string" use="required"/>
        <xs:attribute name="type" type="xs:string" use="required"/>
        <xs:attribute name="name" type="xs:string" use="required"/>
        <xs:attribute name="userDefinedId" type="xs:string" use="optional"/>
        <xs:attribute name="description" type="xs:string" use="optional"/>
    </xs:complexType>
</xs:element>
</xs:schema>

```

A.4 er.xsd

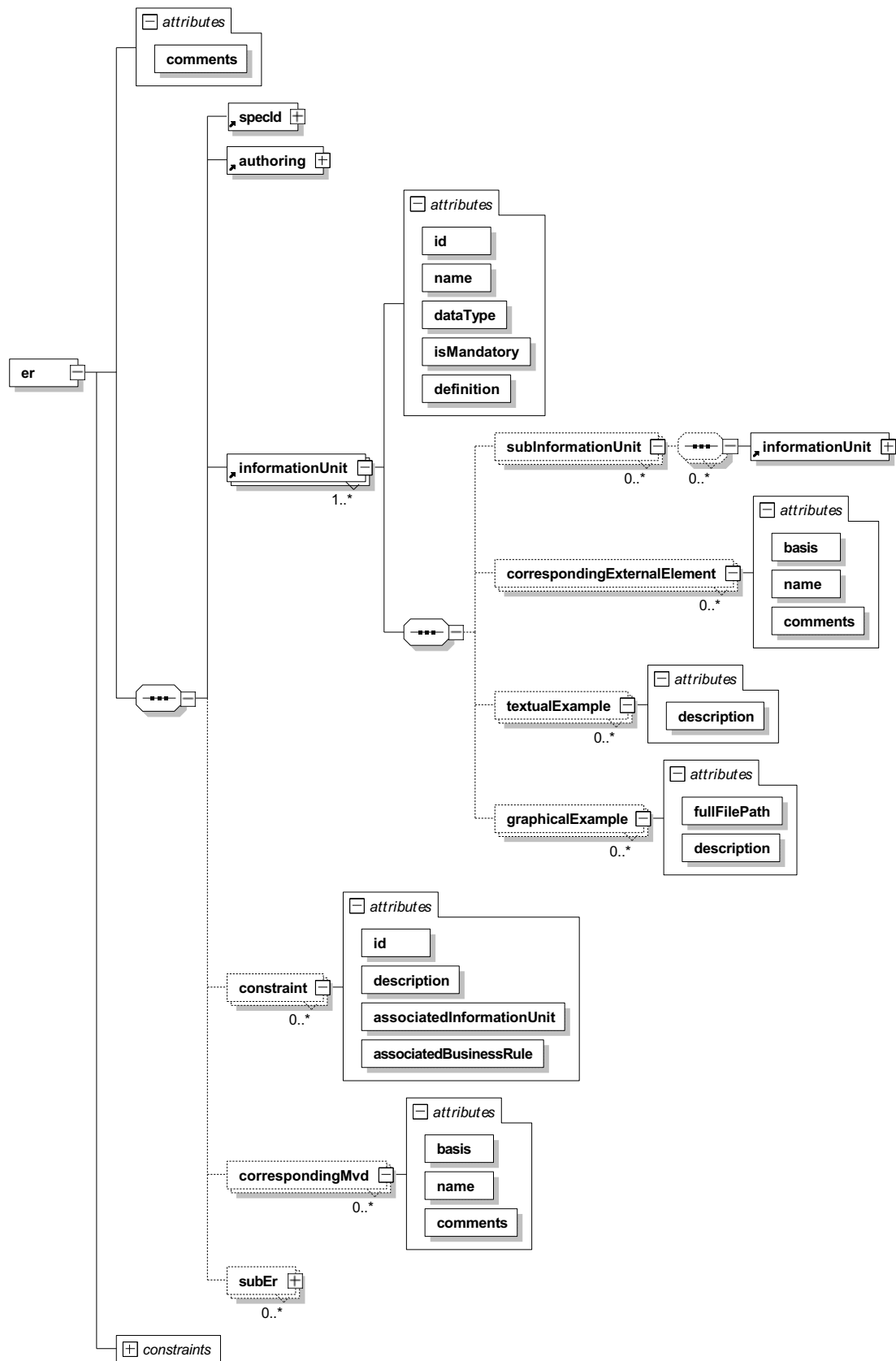


Figure A. 4 - er.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:ids="https://standards.buildingsmart.org/IDM/idsXML/0.2"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="specId.xsd"/>
  <xs:include schemaLocation="authoring.xsd"/>
  <xs:include schemaLocation="uc.xsd"/>
  <xs:element name="er">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="specId"/>
        <xs:element ref="authoring"/>
        <xs:element ref="informationUnit" minOccurs="1" maxOccurs="unbounded"/>
        <xs:element name="constraint" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:attribute name="id" type="xs:string" use="required"/>
            <xs:attribute name="description" type="xs:string" use="required"/>
            <xs:attribute name="associatedInformationUnit" use="optional"/>
            <xs:attribute name="associatedBusinessRule" use="optional"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="correspondingMvd" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:attribute name="basis" type="xs:string"/>
            <xs:attribute name="name" type="xs:string"/>
            <xs:attribute name="comments" type="xs:string"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="subEr" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="er"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
      <xs:attribute name="comments" type="xs:string"/>
    </xs:complexType>
    <xs:key name="key_er_guid">
      <xs:selector xpath="./er/specId"/>
      <xs:field xpath="@guid"/>
    </xs:key>
    <xs:key name="key_informationUnitId">
      <xs:selector xpath="./er/informationUnit"/>
      <xs:field xpath="@id"/>
    </xs:key>
    <xs:key name="key_constraint">
      <xs:selector xpath="./er/constraint"/>
      <xs:field xpath="@id"/>
    </xs:key>
    <xs:keyref name="keyref_associatedInformationUnit" refer="key_informationUnitId">
      <xs:selector xpath="./er/constraint"/>
      <xs:field xpath="@associatedInformationUnit"/>
    </xs:keyref>
    <xs:keyref name="keyref_associatedBusinessRules" refer="key_businessRuleId">
      <xs:selector xpath="./er/constraint"/>
      <xs:field xpath="@associatedBusinessRule"/>
    </xs:keyref>
  </xs:element>
  <!-- Information Unit -->
  <xs:element name="informationUnit">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="subInformationUnit" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence minOccurs="0" maxOccurs="unbounded">
              <xs:element ref="informationUnit"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

```

```

        </xs:complexType>
    </xs:element>
    <xs:element name="correspondingExternalElement" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
            <xs:attribute name="basis" type="xs:string" use="required"/>
            <xs:attribute name="name" type="xs:string" use="required"/>
            <xs:attribute name="comments" type="xs:string"/>
        </xs:complexType>
    </xs:element>
    <xs:element name="textualExample" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
            <xs:attribute name="description" type="xs:string" use="required"/>
        </xs:complexType>
    </xs:element>
    <xs:element name="graphicalExample" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
            <xs:attribute name="fullFilePath" type="xs:string" use="required"/>
            <xs:attribute name="description" type="xs:string" use="optional"/>
        </xs:complexType>
    </xs:element>
</xs:sequence>
<xs:attribute name="id" type="xs:string" use="required"/>
<xs:attribute name="name" type="xs:string" use="required"/>
<xs:attribute name="dataType" type="xs:string" use="required"/>
<xs:attribute name="isMandatory" type="xs:boolean" use="required"/>
<xs:attribute name="definition" type="xs:string" use="required"/>
</xs:complexType>
</xs:element>
</xs:schema>

```

A.5 specId.xsd

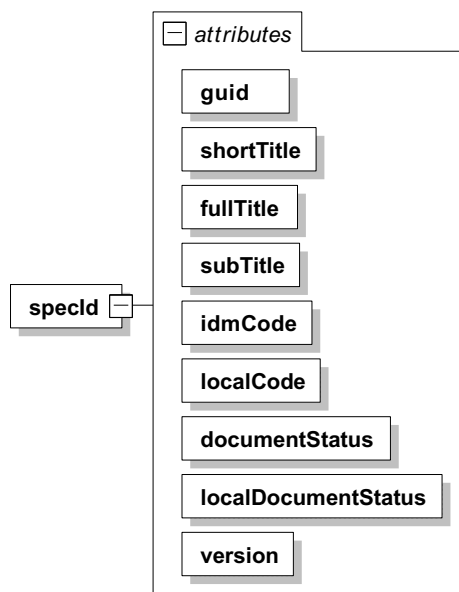


Figure A. 5 - specId.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:idm="https://standards.buildingsmart.org/IDM/idmXML/0.2"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="specId">
    <xs:complexType>
      <xs:attribute name="guid" type="uuid" use="required"/>
      <xs:attribute name="shortTitle" type="xs:string" use="required"/>
      <xs:attribute name="fullTitle" type="xs:string" use="required"/>
      <xs:attribute name="subTitle" type="xs:string" use="optional"/>
      <xs:attribute name="idmCode" type="xs:string" use="required"/>
      <xs:attribute name="localCode" type="xs:string" use="optional"/>
      <xs:attribute name="documentStatus" type="xs:string" use="required"/>
      <xs:attribute name="localDocumentStatus" type="xs:string" use="optional"/>
      <xs:attribute name="version" type="xs:string" use="optional"/>
    </xs:complexType>
  </xs:element>
  <xs:simpleType name="uuid">
    <xs:restriction base="xs:normalizedString">
      <xs:length value="36" fixed="true"/>
      <xs:pattern value="[a-f0-9]{8}-[a-f0-9]{4}-[a-f0-9]{4}-[a-f0-9]{4}-[a-f0-9]{12}"/>
    </xs:restriction>
  </xs:simpleType>
</xs:schema>

```

A.6 authoring.xsd

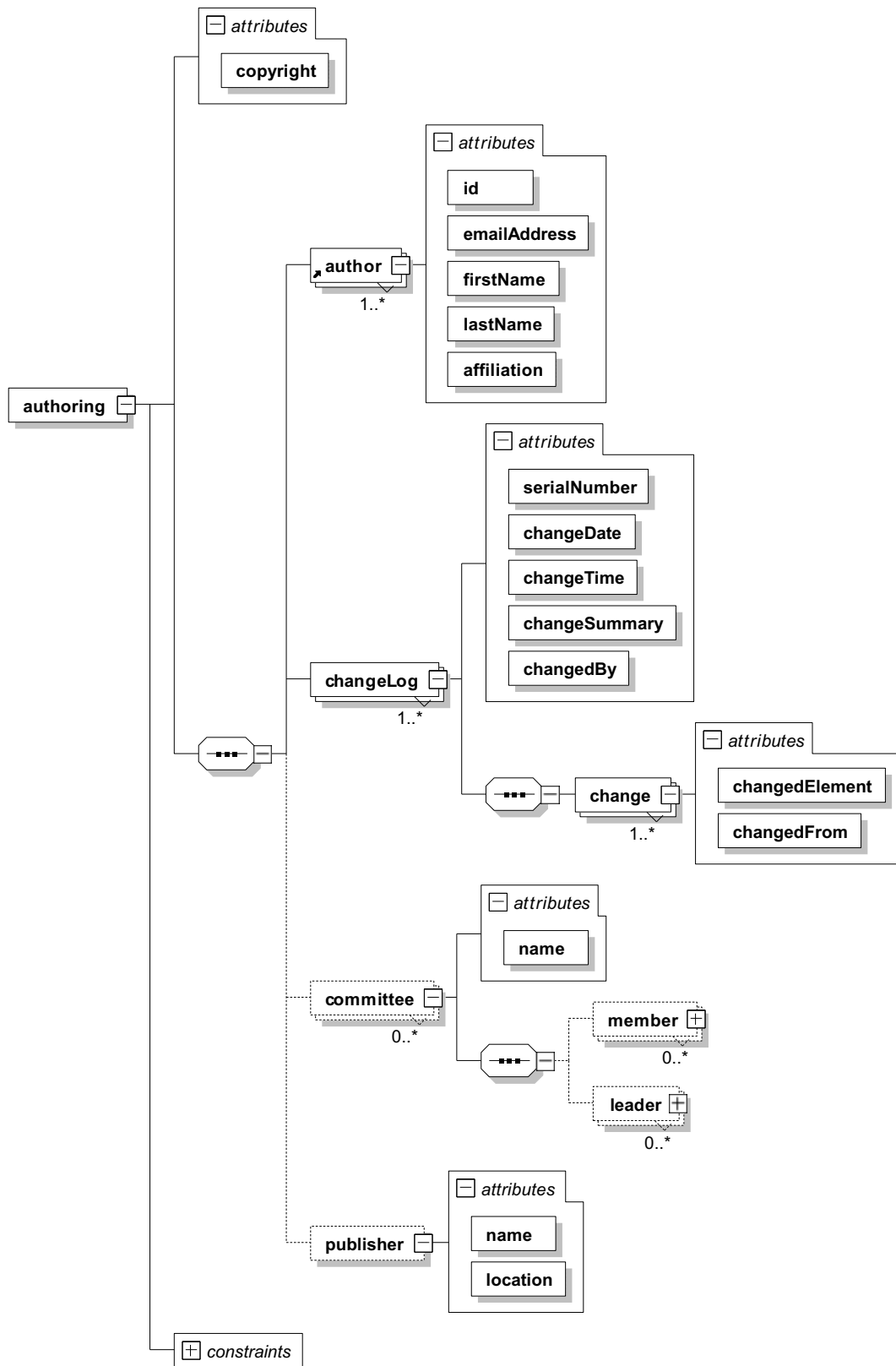


Figure A. 6 - authoring.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:ids="https://standards.buildingsmart.org/IDM/idsXML/0.2"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="authoring">
    <xs:complexType>
      <xs:sequence>
        <xs:element ref="author" maxOccurs="unbounded"/>
        <xs:element name="changeLog" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="change" minOccurs="1" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="changedElement" type="xs:string" use="required"/>
                  <xs:attribute name="changedFrom" type="xs:string" use="required"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="serialNumber" type="xs:string" use="required"/>
            <xs:attribute name="changeDate" type="xs:date" use="required"/>
            <xs:attribute name="changeTime" type="xs:time" use="required"/>
            <xs:attribute name="changeSummary" type="xs:string" use="required"/>
            <xs:attribute name="changedBy" type="xs:NCName" use="required"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="committee" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="member" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="memberId" type="xs:NCName" use="optional"/>
                </xs:complexType>
              </xs:element>
              <xs:element name="leader" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="leaderId" type="xs:NCName" use="optional"/>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="name" type="xs:string" use="required"/>
          </xs:complexType>
        </xs:element>
        <xs:element name="publisher" minOccurs="0" maxOccurs="1">
          <xs:complexType>
            <xs:attribute name="name" type="xs:string" use="required"/>
            <xs:attribute name="location" type="xs:string" use="optional"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
      <xs:attribute name="copyright" type="xs:string" use="optional"/>
    </xs:complexType>
    <xs:key name="key_serialNumber">
      <xs:selector xpath="./authoring/changeLog | ./uc/authoring/changeLog
| ./pm/authoring/changeLog | ./er/authoring/changeLog"/>
      <xs:field xpath="@serialNumber"/>
    </xs:key>
    <xs:key name="key_authorId">
      <xs:selector xpath="./authoring/author | ./uc/authoring/author | ./pm/authoring/author
| ./er/authoring/author"/>
      <xs:field xpath="@id"/>
    </xs:key>
    <xs:keyref name="keyref_changedBy" refer="key_authorId">
      <xs:selector xpath="./authoring/author | ./uc/authoring/author | ./pm/authoring/author
| ./er/authoring/author"/>
      <xs:field xpath="@id"/>
    </xs:keyref>
    <xs:keyref name="keyref_member" refer="key_authorId">

```



```

        <xs:selector xpath="./authoring/committee/member | ./uc/authoring/committee/member
| ./pm/authoring/committee/member | ./er/authoring/committee/member"/>
        <xs:field xpath="@memberId"/>
    </xs:keyref>
    <xs:keyref name="keyref_leader" refer="key_authorId">
        <xs:selector xpath="./authoring/committee/leader | ./uc/authoring/committee/leader
| ./pm/authoring/committee/leader | ./er/authoring/committee/leader"/>
        <xs:field xpath="@leaderId"/>
    </xs:keyref>
</xs:element>
<!--Author-->
<xs:element name="author">
    <xs:complexType>
        <xs:attribute name="id" type="xs:string" use="required"/>
        <xs:attribute name="emailAddress" type="xs:string" use="required"/>
        <xs:attribute name="firstName" type="xs:string" use="required"/>
        <xs:attribute name="lastName" type="xs:string" use="required"/>
        <xs:attribute name="affiliation" type="xs:string" use="optional"/>
    </xs:complexType>
</xs:element>
</xs:schema>

```

Bibliography

- [1] ISO 29481-1, Building information models — Information delivery manual — *Part 1: Methodology and format*
- [2] ISO 29481-2, Building information models — Information delivery manual — *Part 2: Interaction framework*