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Information technology — Metadata registries (MDR) —

Part 1:
Framework

Technologies de l'information — Registres de métadonnées (RM) —

Partie 1: Cadre de référence

Reference number
ISO/IEC 11179-1:2015(E)

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Foreword

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

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The committee responsible for this document is ISO/IEC JTC1, *Information technology*, SC32, *Data management and interchange*.

This third edition of ISO 11179-1 cancels and replaces ISO 11179-1:2004, which has been technically revised.

ISO/IEC 11179 consists of the following parts, under the general title *Information technology — Metadata registries (MDR)*:

— *Part 1: Framework*

— *Part 2: Classification*

— *Part 3: Registry metamodel and basic attributes*

— *Part 4: Formulation of data definitions*

— *Part 5: Naming principles*

— *Part 6: Registration*

Introduction

ISO/IEC 11179 addresses the semantics of data, the representation of data and the registration of the descriptions of that data. It is through these descriptions that an accurate understanding of the semantics and a useful depiction of the data are found.

The purposes of ISO/IEC 11179 is to promote the following:

— standard description of data;

— common understanding of data across organizational elements and between organizations;

— re-use and standardization of data over time, space, and applications;

— harmonization and standardization of data within an organization and across organizations;

— management of the components of descriptions of data;

— re-use of the components of descriptions of data.

Each part of ISO/IEC 11179 is devoted to addressing a different aspect of these needs:

— Part 1: *Framework* – Contains an overview of the Standard and describes the basic concepts;

— Part 2: *Classification* – Describes how to manage a classification scheme in a metadata registry;

— Part 3: *Registry metamodel and basic attributes* – Provides the conceptual model, including the basic attributes and relationships, for a metadata registry;

— Part 4: *Formulation of data definitions* – Gives rules and guidelines for forming quality definitions for data elements and their components;

— Part 5: *Naming principles* – Describes how to form conventions for naming data elements and their components;

— Part 6: *Registration* – Specifies the roles and requirements for the registration process in an ISO/IEC 11179 metadata registry.

Generally, descriptive data are known as metadata. Metadata can describe books, phone calls, data, etc. ISO/IEC 11179 focuses upon metadata that describes data.

NOTE In ISO/IEC 11179 (all parts), metadata refers to descriptions of data. It does not contain a general treatment of metadata.

A metadata registry (MDR) is a database of metadata. Registration is one possible function of that database. Registration accomplishes three main goals: identification, provenance, and monitoring quality. Identification is accomplished by assigning a unique identifier (within the registry) to each object registered there. Provenance addresses the source of the metadata and the object described. Monitoring quality ensures that the metadata does the job it is designed to do.

An MDR may contain the semantics of data. An understanding of data is fundamental to their design, harmonization, standardization, use, re-use and interchange. The underlying model for an MDR is designed to capture all the basic components of the semantics of data, independent of any application or subject matter area.

MDRs, typically, are organized so that those designing applications can ascertain whether a suitable object described in the MDR already exists. Where it is established that a new object is essential, its derivation from an existing description with appropriate modifications is encouraged, thus avoiding unnecessary variations in the way similar objects are described. Registration will also allow two or more administered items describing identical objects to be identified, and more importantly, it will help to identify situations where similar or identical names are in use for administered items that are significantly different in one or more respects.

In ISO/IEC 11179 the basic container for data is called a data element. It may exist purely as an abstraction or exist in some application system. In either case, the description of a data element is the same in ISO/IEC 11179. Data element descriptions have both semantic and representational components. The semantics are further divided into contextual and symbolic types.

The contextual semantics are described by the data element concept (DEC). The DEC describes the kind of objects for which data are collected and the particular characteristic of those objects being measured. The symbolic semantics are described by the conceptual domain (CD). A CD is a set of concepts, not necessarily finite, where the concepts represent the meaning of the permissible values in a value domain. A value domain contains the allowed values for a data element.

The names, definitions, datatype and related attributes that are associated with the description of an object in an MDR give that object meaning. The depth of this meaning is limited, because names and definitions convey limited information about the object. The relationships object descriptions have with semantically related object descriptions in a registry provide additional information, but this additional information is dependent on how many semantically related object descriptions there are.

This third edition of ISO/IEC 11179-1 introduces concepts and concept systems in the description of the semantics of data. Object classes, properties, DECs, value meanings and CDs are concepts. Therefore, they have definitions and may be designated by names or codes. They may also be organized through the use of relations among them into concept systems. A classification scheme is a concept system that is used for classifying some objects and classification of an object adds meaning to that object.

Features needed for formal reasoning are also new to this third edition of ISO/IEC 11179-1. Applying the rules of some form of formal logic (1st order logic, predicate calculus, description logic, etc.) may add additional abilities to query and reason with concept systems. Ontologies are concept systems that allow the application of formal logic and this edition provides for their use.

The representational component is about the permitted values a data element may use. Each such permissible value is a designation of one of the concepts in the CD. The set of these permissible values is called a value domain (VD). A VD specifies all the values that are allowed either through an enumeration, a rule, or a combination of these. The computational model the values follow is given by their datatype.

The semantic and representational components are described through attributes contained in the conceptual model of a metadata registry as specified in ISO/IEC 11179-3. A metadata registry that conforms to ISO/IEC 11179 can describe a wide variety of data. In fact, the attributes described in ISO/IEC 11179-3 are data elements, and they can be registered in an ISO/IEC 11179 metadata registry. Moreover, any set of descriptors or metadata attributes may be interpreted as data elements and registered in the metadata registry.

There are two main consequences to this:

— the metadata registry can describe itself;

— metadata layers or levels are not defined in ISO/IEC 11179.

As a result, ISO/IEC 11179 is a general description framework for data of any kind, in any organization and for any purpose. ISO/IEC 11179 does not address other data management needs, such as data models, application specifications, programming code, program plans, business plans and business policies. These need to be addressed elsewhere.

The increased use of data processing and electronic data interchange heavily relies on accurate, reliable, controllable and verifiable data recorded in databases. One of the prerequisites for a correct and proper use and interpretation of data is that both users and owners of data have a common understanding of the meaning and descriptive characteristics (e.g., representation) of that data, guaranteed by the definition of several basic attributes.

The basic attributes specified are applicable for the definition and specification of the contents of data dictionaries and interchanging or referencing among various collections of administered items. The "basic" in basic attributes means that the attributes are commonly needed in specifying administered items completely enough to ensure that they will be applicable for a variety of functions, such as:

— design of information processing systems,

— retrieval of data from databases,

— design of messages for data interchange,

— maintenance of metadata registries,

— data management,

— dictionary design,

— dictionary control,

— use of information processing systems.

Basic also implies that they are independent of any:

— application environment,

— function of an object described by an administered item,

— level of abstraction,

— grouping of administered items,

— method for designing information processing systems or data interchange messages,

— MDR system.

Basic does not imply that all attributes specified in ISO/IEC 11179-3 are required in all cases. Distinction is made between those attributes that are mandatory, conditional, or optional.

Information technology — Metadata registries (MDR) —

Part 1:
Framework

1 Scope

This part of ISO/IEC 11179 provides the means for understanding and associating the individual parts of ISO/IEC 11179 and is the foundation for a conceptual understanding of metadata and metadata registries.

This part of ISO/IEC 11179 is applicable to the formulation of data representations, concepts, meanings and relationships to be shared among people and machines, independent of the organization that produces the data. It is not applicable to the physical representation of data as bits and bytes at the machine level.

In this part of ISO/IEC 11179 (and all other parts), metadata refers to descriptions of data. It does not contain a general treatment of metadata.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 704:2009, *Terminology work — Principles and methods*

ISO 1087-1:2000, *Terminology work — Vocabulary — Part 1: Theory and application*

ISO/IEC 11179 (all parts), *Information technology — Metadata registries (MDR)*

3 Terms, definitions and abbreviations

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

3.1 Definitions of modelling constructs

3.1.1
attribute
characteristic (3.2.2) of an *object* (3.2.22) or set of objects

3.1.2
class
description of a set of *objects* (3.2.22) that share the same *attributes* (3.1.1), operations, methods, *relationships* (3.1.4) and semantics

[SOURCE: ISO/IEC 19505-2:2012, 7.3.7 modified]

3.1.3
identifier
<metadata registry> sequence of characters, capable of uniquely identifying that with which it is associated, within a specified *context* (3.3.7)

Note 1 to entry: A name should not be used as an identifier because it is not linguistically neutral.

Note 2 to entry: It is possible to define an identifier from the point of view of terminology as defined in ISO 1087-1 and described in ISO 704, as follows: representation of an object by a sign which denotes it, and is intended for dereferencing that object. Note the parallel with the definition of designation, except this applies to any object rather than just for concepts.

3.1.4
relationship
connection among model elements

[SOURCE: ISO/IEC 19505-2:2012, 7.3.47 modified]

3.2 General terms used in this part of ISO/IEC 11179

3.2.1
basic attribute
attribute (3.1.1) of a *metadata item* (3.2.17) commonly needed in its specification

3.2.2
characteristic
abstraction of a property of an *object* (3.2.22) or of a set of objects

[SOURCE: ISO 1087-1:2000, 3.2.4]

Note 1 to entry: Characteristics are used for describing concepts.

3.2.3
concept
unit of knowledge created by a unique combination of *characteristics* (3.2.2)

[SOURCE: ISO 1087-1:2000, 3.2.1]

3.2.4
concept system
set of *concepts* (3.2.3) structured according to the relations among them

[SOURCE: ISO 1087-1:2000, 3.2.11]

3.2.5
conceptual data model
conceptual model
data model (3.2.7) that represents an abstract view of the real world

Note 1 to entry: A conceptual model represents the human understanding of a system.

3.2.6
data
reinterpretable representation of information in a formalized manner suitable for communication, interpretation or processing

[SOURCE: ISO 2382-1:2015, 2121272 — Notes to entry modified]

Note 1 to entry: Data can be processed by humans or by automatic means.

Note 2 to entry: Data may also be described using the terminological notions defined in ISO 1087-1:2000 and the computational notions defined in ISO/IEC 11404:2007. A datum is a designation of a concept with a notion of equality defined for that concept.

3.2.7
data model
graphical and/or lexical representation of *data* (3.2.6), specifying their properties, structure, and inter-relationships

3.2.8
definition
representation of a *concept* (3.2.3) by a descriptive statement which serves to differentiate it from related concepts

[SOURCE: ISO 1087-1:2000, 3.3.1]

3.2.9
designation
representation of a *concept* (3.2.3) by a sign which denotes it

[SOURCE: ISO 1087-1:2000, 3.4.1]

3.2.10
entity
any concrete or abstract thing that exists, did exist, or might exist, including associations among these things

Note 1 to entry: An entity exists whether data about it are available or not.

EXAMPLE A person, object, event, idea, process, etc.

3.2.11
essential characteristic
characteristic (3.2.2) which is indispensable to understanding a *concept* (3.2.3)

[SOURCE: ISO 1087-1:2000, 3.2.6]

3.2.12
extension
<terminology> totality of *objects* (3.2.22) to which a *concept* (3.2.3) corresponds

[SOURCE: ISO 1087-1:2000, 3.2.8]

Note 1 to entry: This term has a different meaning in ISO/IEC 11179-3.

3.2.13
general concept
concept (3.2.3) which corresponds to two or more *objects* (3.2.22), which form a group by reason of common properties

[SOURCE: ISO 1087-1:2000, 3.2.3]

Note 1 to entry: Examples of general concepts are 'planet', 'tower'.

3.2.14
individual concept
concept (3.2.3) which corresponds to only one *object* (3.2.22)

[SOURCE: ISO 1087-1:2000, 3.2.2]

Note 1 to entry: Examples of individual concepts are: 'Saturn', 'the Eiffel Tower'.

3.2.15
intension
<terminology> set of *characteristics* (3.2.2) which makes up the *concept* (3.2.3)

[SOURCE: ISO 1087-1:2000, 3.2.9]

3.2.16
metadata
data (3.2.6) that defines and describes other data

3.2.17
metadata item
instance of a *metadata object* (3.2.18)

3.2.18
metadata object
object type defined by a *metamodel* (3.2.20)

3.2.19
metadata registry
MDR
information system for registering *metadata* (3.2.16)

3.2.20
metamodel
data model (3.2.7) that specifies one or more other models, such as data models, process models, ontologies, etc

3.2.21
name
designation (3.2.9) of an *object* (3.2.22) by a linguistic expression

3.2.22
object
anything perceivable or conceivable

[SOURCE: ISO 1087-1:2000, 3.1.1]

Note 1 to entry: Objects may also be material (e.g., an engine, a sheet of paper, a diamond), immaterial (e.g., a conversion ratio, a project plan), or imagined (e.g., a unicorn).

3.2.23
registry item
metadata item (3.2.17) recorded in a *metadata registry* (3.2.19)

3.2.24
registry metamodel
metamodel (3.2.20) specifying a *metadata registry* (3.2.19)

3.2.25
terminological system
concept system (3.2.4) with *designations* (3.2.9) for each *concept* (3.2.3)

3.3 Alphabetical list of terms used in the metamodel

3.3.1
administered item
registry item (3.2.23) for which *administrative information* (3.3.2) is recorded

Note 1 to entry: This entry is defined more generally than it is in ISO/IEC 11179-3.

3.3.2
administrative information
<metadata registry> information about the administration of an item in a *metadata registry* (3.2.19)

EXAMPLE creation date, last change date, origin, change description, explanatory comment

3.3.3
administrative status
designation (3.2.9) of the status in the administrative process of a *registration authority* (3.3.25) for handling registration requests

Note 1 to entry: The values and associated meanings of "administrative status" are determined by each registration authority. C.f. registration status.

3.3.4
classification scheme
descriptive information for an arrangement or division of *objects* (3.2.22) into groups based on criteria such as *characteristics* (3.2.2), which the objects have in common

Note 1 to entry: A classification scheme is a concept system used for classifying some objects.

EXAMPLE Origin, composition, structure, application, function, etc.

3.3.5
classification scheme item
CSI
item of content in a *classification scheme* (3.3.4)

Note 1 to entry: This may be a node in a taxonomy or ontology, a term in a thesaurus, etc.

3.3.6
conceptual domain
CD
concept (3.2.3) whose meaning is expressed as an enumerated set and/or a description of subordinate concepts, which are *value meanings* (3.3.32)

Note 1 to entry: This definition is more general than the one specified in ISO/IEC 11179-3.

3.3.7
context
circumstance, purpose, and perspective under which an *object* (3.2.22) is defined or used

Note 1 to entry: The definition is not the same as in 11179–3. The term is used in this part of ISO/IEC 11179 as defined here.

3.3.8
data element
DE
unit of *data* (3.2.6) that is considered in *context* (3.3.7) to be indivisible

[SOURCE: ISO/IEC 15944-1:2011, 3.16]

Note 1 to entry: The definition states that a data element is "indivisible" in some context. This means it is possible that a data element considered indivisible in one context (e.g., telephone number) may be divisible in another context (e.g., country code, area code, local number).

3.3.9
data element concept
DEC
concept (3.2.3) that is an association of a *property* (3.3.21) with an *object class* (3.3.18)

Note 1 to entry: A data element concept is implicitly associated with both the property and the object class whose combination it expresses.

Note 2 to entry: A data element concept may also be associated with zero or more conceptual domains each of which expresses its value meanings.

Note 3 to entry: A data element concept may also be associated with zero or more data elements each of which provides representation for the data element concept via its associated value domain.

3.3.10
datatype
set of distinct values, characterized by properties of those values and by operations on those values

[SOURCE: ISO/IEC 11404:2007, 4.11]

3.3.11
described conceptual domain
conceptual domain (3.3.6) that is specified by a description or specification, such as a rule, a procedure, or a range (i.e., interval)

3.3.12
described conceptual domain description
description or specification of a rule, reference, or range for a set of all *value meanings* (3.3.32) for the *conceptual domain* (3.3.6)

3.3.13
described value domain
value domain (3.3.31) that is specified by a description or specification, such as a rule, a procedure, or a range (i.e., interval)

3.3.14
described value domain description
description or specification of a rule, reference, or range for a set of all *permissible values* (3.3.20) for the *value domain* (3.3.31)

3.3.15
dimensionality
set of equivalent *units of measure* (3.3.29)

Note 1 to entry: Equivalence between two units of measure is determined by the existence of a quantity preserving one-to-one correspondence between values measured in one unit of measure and values measured in the other unit of measure, independent of context, and where characterizing operations are the same.

Note 2 to entry: The equivalence defined here forms an equivalence relation on the set of all units of measure. Each equivalence class corresponds to a dimensionality. The units of measure “temperature in degrees Fahrenheit” and “temperature in degrees Celsius” have the same dimensionality, because:

a) given a value measured in degrees Fahrenheit there is a value measured in degrees Celsius with the same quantity, and vice-versa, by the well-known correspondences °C = (5/9)*(°F - 32) and °F = (9/5)*(°C) + 32.

b) the same operations can be performed on both values.

Note 3 to entry: The units of measure “temperature in degrees Celsius” and “temperature in degrees Kelvin” do not belong to the same dimensionality. Even though it is easy to convert quantities from one unit of measure to the other (°C = °K – 273.15 and °K = °C + 273.15), the characterizing operations in Kelvin include taking ratios, whereas this is not the case for Celsius. For instance, 20° K is twice as warm as 10° K, but 20° C is not twice as warm as 10° C.

Note 4 to entry: Units of measure are not limited to physical categories. Examples of physical categories are: linear measure, area, volume, mass, velocity, time duration, and temperature. Examples of non-physical categories are: currency, quality indicator, colour intensity

Note 5 to entry: Quantities may be grouped together into categories of quantities which are mutually comparable. Lengths, diameters, distances, heights, wavelengths and so on would constitute such a category. Mutually comparable quantities have the same dimensionality. ISO 80000-1 calls these “quantities of the same kind”.

Note 6 to entry: ISO 80000-1 specifies physical dimensions (e.g., length, mass, velocity). This part of ISO/IEC 11179 also permits non-physical dimensions (e.g., value dimensions such as: currency, quality indicator). The present concept of dimensionality equates to what ISO 80000-1 calls Dimensional Product, rather than to Dimension.

3.3.16
enumerated conceptual domain
conceptual domain (3.3.6) that is specified by a list of all its *value meanings* (3.3.32)

Note 1 to entry: No ordering of the value meanings is implied.

3.3.17
enumerated value domain
value domain (3.3.31) that is specified by a list of all its *permissible values* (3.3.20)

Note 1 to entry: No ordering of the permissible values is implied.

3.3.18
object class
set of ideas, abstractions, or things in the real world that are identified with explicit boundaries and meaning and whose properties and behaviour follow the same rules

3.3.19
organization
unique framework of authority within which a person or persons act, or are designated to act, towards some purpose

[SOURCE: ISO/IEC 6523-1:1998, 3.1]

3.3.20
permissible value
designation (3.2.9) of a *value meaning* (3.3.32)

Note 1 to entry: A permissible value may be associated with one or more enumerated value domains.

Note 2 to entry: As a designation, the value is the sign and the value meaning is the concept.

3.3.21
property
characteristic (3.2.2) common to all members of an *object class* (3.3.18)

3.3.22
registrar
representative of a *registration authority* (3.3.25)

3.3.23
registration
<generic>inclusion of an item in a registry

3.3.24
registration
<metadata registry> inclusion of a *metadata item* (3.2.17) in a *metadata registry* (3.2.19)

3.3.25
registration authority
RA
organization (3.3.19) responsible for maintaining a register

3.3.26
registration authority identifier
RA identifier
identifier (3.1.3) assigned to a *registration authority* (3.3.25)

3.3.27
registration status
designation (3.2.9) of the status in the registration life-cycle of an *administered item* (3.3.1)

3.3.28
representation class
classification of types of representations

3.3.29
unit of measure
actual units in which the associated *values* (3.3.30) are measured

Note 1 to entry: The dimensionality of the associated conceptual domain must be appropriate for the specified unit of measure.

3.3.30
value
<ISO 704> sign, used to represent *data* (3.2.6)

Note 1 to entry: A value is a sign as used in ISO 1087:2000 and ISO 704:2009.

Note 2 to entry: A value may be a character string, bitmap, or some other symbol.

Note 3 to entry: This definition is more general than the one specified in ISO/IEC 11179-3.

3.3.31
value domain
VD
set of *permissible values* (3.3.20)

Note 1 to entry: The permissible values in a value domain may either be enumerated or expressed via a description.

3.3.32
value meaning
<ISO 704> property

Note 1 to entry: ISO 704 and ISO/IEC 11179 use the term property to mean different ideas.

Note 2 to entry: This definition is more general than the one specified in ISO/IEC 11179-3.

3.3.33
version
unique *version identifier* (3.1.3) of the *administered item* (3.3.1)

3.4 Specific terms used in ISO/IEC 11179-6

3.4.1
stewardship
<metadata> responsibility for the maintenance of *administrative information* (3.3.2) applicable to one or more *administered items* (3.3.1)

Note 1 to entry: The responsibility for the registration of metadata may be different from the responsibility for stewardship of metadata.

3.4.2
stewardship organization
StO
organization (3.3.9) that maintains *stewardship* (3.4.1) of an *administered item* (3.3.1)

Note 1 to entry: In the second edition of ISO/IEC 11179-6, this was called *responsible organization*.

3.4.3
submission organization
submitting organization
SuO
organization (3.3.9) that submits a *metadata item* (3.2.17) for *registration* (3.3.23)

3.5 Specific terms used in this part of ISO/IEC 11179

3.5.1
data construct
object (3.2.22) a *metadata item* (3.2.17) describes

Note 1 to entry: Individual data elements, value domains, data element concepts, conceptual domains, object classes, and properties are data constructs.

3.5.2
quantity
permissible value (3.3.20) associated with a *unit of measure* (3.3.29)

4 Theory of terminology

This clause describes the concepts from the theory of terminology that are used in this part of ISO/IEC 11179. They are mostly taken from ISO 704 and ISO 1087-1. They provide the background and a more thorough explanation of the theory of terminology.

In the theory of terminology, an **object** is something conceivable or perceivable. **Concepts** are mental constructs, units of thought, or units of knowledge created by a unique combination of characteristics. Concepts are organized or grouped by **characteristics**, which are also concepts. Any concept may be a characteristic; being a characteristic is a role for a concept. **Essential characteristics** are indispensable to understanding a concept, and they differentiate them, though which characteristics are essential depends on context. For instance, the concept *person* has sex, age, marital status, educational attainment, and race/ethnicity as essential characteristics in demography; however, it has name, sex, date/time of birth, height, weight, and mother's name as essential characteristics in a birth records system. For zoology, the essential characteristics of a person are different still. Other characteristics are inessential. The sum of characteristics for a concept is called its **intension**. The totality of objects a concept corresponds to is its **extension**.

In natural language, concepts are expressed through **definitions**, which specify a unique intension and extension.

A **designation** (term, appellation, or symbol) is the representation of a concept by a sign, which denotes it.

A **general concept** has two or more objects that correspond to it. An **individual concept** has one object that corresponds to it. That is, a general concept has two or more objects in its extension, and an individual concept has one object in its extension.

A **concept system** is set of concepts structured according to the relations among them. A **terminological system** is a concept system with designations for each concept.

5 Metadata

5.1 General

For ISO/IEC 11179 (all parts), **metadata** is defined to be data that defines and describes other data.

NOTE In general, metadata is descriptive data about an object; in ISO/IEC 11179 that object is "data".

This means that metadata are data, and data become metadata when they are used in this way. This happens under particular circumstances, for particular purposes, and with certain perspectives, as no data are always metadata. The set of circumstances, purposes, or perspectives for which some data are used as metadata is called the **context**. So, metadata are data about data in some context.

Since metadata are data, then metadata can be stored in a database and organized through the use of a model. Some models are very application specific, and others are more general. The model presented and described in ISO/IEC 11179-3 is general. It is a representation of the human understanding of the metadata needed to describe **data constructs**, including the relationships that exist among that metadata, and not necessarily how the metadata will be represented in an application of an MDR. A model of this kind is called a **conceptual model**. Conceptual models are meant for people to read and understand.

Models that describe metadata are often referred to as **metamodels**. The conceptual model presented in ISO/IEC 11179-3 is a metamodel in this sense.

5.2 Concepts

5.2.1 General

Several data constructs used in ISO/IEC 11179 are concepts. They are data element concept, object class, property, conceptual domain and value meaning. These are discussed in more detail in 5.3 and 5.5.

The semantics of data come from the concepts used in their descriptions. The meanings of all the concepts used to describe a datum are combined into a story, sometimes called a fact. This is equivalent to the information conveyed by some datum.

As ISO/IEC 11179-5 describes, the names for data elements, which may convey some of the semantics of their underlying data, can be constructed from the designations of their constituent concepts. So, for some datum, the story it conveys might be written as “The temperature in Washington, DC at the bottom of the Washington Monument on 14 June 2013 at 1600 ET was 78 °F”. The designations of concepts (temperature; Washington, DC; Washington Monument, 1600 ET, and 78 °F) are interspersed with English words to create a sentence, which contains the story.

Finally, the relationships some concepts have with others, as defined in a concept system, add semantics to data. For instance, the concept of a temperature measurement is different if it is a measure of the kinetic activity of molecules of air in some location on Earth versus a measure of ambient infrared radiation in inter-planetary space between Jupiter and Saturn. In both cases, instances of temperature are ultimately measures of infrared radiation, but they are obtained far differently. The temperature of air is directly determined by the motion of molecules. There are far too few molecules in inter-planetary space for the same kind of measurement to be meaningful. A different sort of measurement is required.

5.2.2 Management

Looking across all the data elements found in an organization or across organizations, one finds many concepts that are the same. For instance, in statistical survey organizations, data are collected and estimates produced for some population. But surveys are often conducted on a regular basis – monthly, quarterly, yearly – so the population is repeated. Moreover, many surveys might be conducted on the same population, each for its own specialized purpose. A similar situation applies in a scientific research laboratory, where in a large program, the same scientific experiments are conducted repeatedly.

Since some of the purposes of the MDR are understanding, re-use, harmonization, and standardization of data, then managing meanings is critical for those needs. In the case of re-use in particular, where the same meanings are applied in different situations, it is inefficient, error prone, redundant, and inhibitory to store one concept multiple times. If the same concept is used to describe many data elements, describe it once and re-use it.

5.3 Fundamental model of data elements

For the purposes of ISO/IEC 11179 (all parts), a **data element** comprises two parts:

— **Data element concept**,

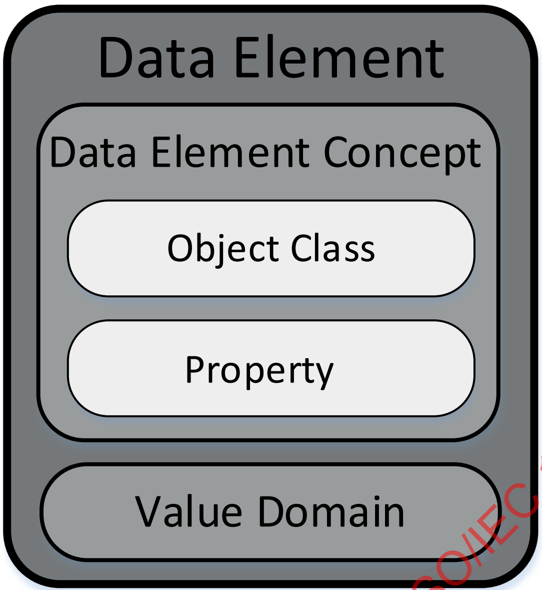
— **Value domain**.

A **data element concept** also comprises two parts:

— **Object class**,

— **Property**.

Figure 1 illustrates the fundamental model of data elements.



NOTE In Figure 1, if a Region B is contained within the boundary of a Region A, then the Region A comprises the Region B (and possibly others).

Figure 1 — Fundamental, informal model of a data element

The totality of objects for which we wish to collect and store data is the extension of an object class. Object classes are concepts, and they correspond to the notions embodied in classes in object-oriented models and entities in entity-relationship models. Examples are cars, persons, households, employees, jobs, and orders. Properties are what humans use to distinguish or describe object classes. They are characteristics, not necessarily essential ones, of the object class and form its intension. They are also concepts, and they correspond to the notions embodied in attributes (without associated datatypes) in object-oriented or entity-relationship models. Examples of properties are colour, model, sex, age, income, address, salary or price.

An object class may be a **general concept**. This happens when the totality of objects corresponding to the object class has two or more members. The examples in the previous paragraph are of this type. Record level data are described this way. On the other hand, an object class may be an **individual concept**. This happens when the totality of objects corresponding to the object class has one member. An example is a concept corresponding to a single object, such as “the collection of all persons”. Another example is “the collection of service sector establishments”. Aggregate data are described this way. Examples of properties for these object classes are average income or total earnings, respectively.

It is important to distinguish an actual object class or property from its name. This is the distinction between concepts and their designations. Object classes and properties are concepts; their names are designations. Complications arise because people convey concepts through words (designations), and it is easy to confuse a concept with the designation used to represent it. For example, most people will read the word income and be certain they have unambiguously interpreted it. But, the designation income may not convey the same concept to all readers, and, more importantly, each instance of income may not designate the same concept.

Not all ideas are simply expressed in a natural language, either. For example, “women between the ages of 15 and 45 who have had at least one live birth in the last 12 months” is a valid object class not easily named in English. Some ideas may be more easily expressed in one language than in another. The German word *Götterdämmerung* has no simple English equivalent, for instance.

Value domains are sets of **permissible values** for data elements. **Datatype** and (possibly) a **unit of measure** are associated with a value domain. For example, the data element representing annual household income may have the set of non-negative integers (with units of dollars) in Arabic numerals as a set of valid values. This is its value domain. The scaled datatype is appropriate for this situation (see ISO/IEC 11404:2007, 8.1.9). Currency is a likely **representation class**, and dollars a unit of measure.

A data element concept may be associated with different value domains as needed to form conceptually similar data elements. There are many ways to represent similar details about the world, but the data element concept for which the details are examples is the same. Take the DEC country of person's birth as an example. ISO 3166-1:2013 contains seven different representations for countries of the world. Each one of these seven representations contains a set of values that may be used in the value domain associated with the DEC. Each one of the seven associations is a data element. For each representation of the data, the permissible values, the datatype, and possibly the units of measure, are altered.

See ISO/IEC/TR 20943-1 for details about the registration and management of descriptions of data elements.

5.4 Data elements in data management and interchange

Data elements appear in two basic situations: in databases and in messages. Databases are rendered either in memory or in files stored separately. Data elements are the fundamental units of data an organization manages, therefore they must be part of the design of databases within the organization and all messages the organization builds to communicate data to other organizations.

Within the organization, databases are composed of records, segments, tuples, rows within tables, etc., which are composed of data elements. The data elements themselves contain various kinds of data that include characters, images, sound, etc.

When the organization needs to transfer data to another organization, data elements are the fundamental units that make up the message. Messages occur between databases, between databases and humans, and between humans. Moreover, the structure (i.e. the records or tuples) of databases don't have to be the same across organizations. So, the common unit for transferring data and related information is the data element.

5.5 Fundamental model of value domains

Figure 2 illustrates the fundamental model of value domains.

A **value domain** is a set of permissible values. A **permissible value** is the association of some **value** and the meaning for that value. The associated meaning is called the **value meaning**. A value domain is the set of valid values for one or more data elements. It is used for validation of data in information systems and in data exchange. It is also an integral part of the metadata needed to describe a data element. In particular, a value domain is a guide to the content, form, and structure of the data represented by a data element.

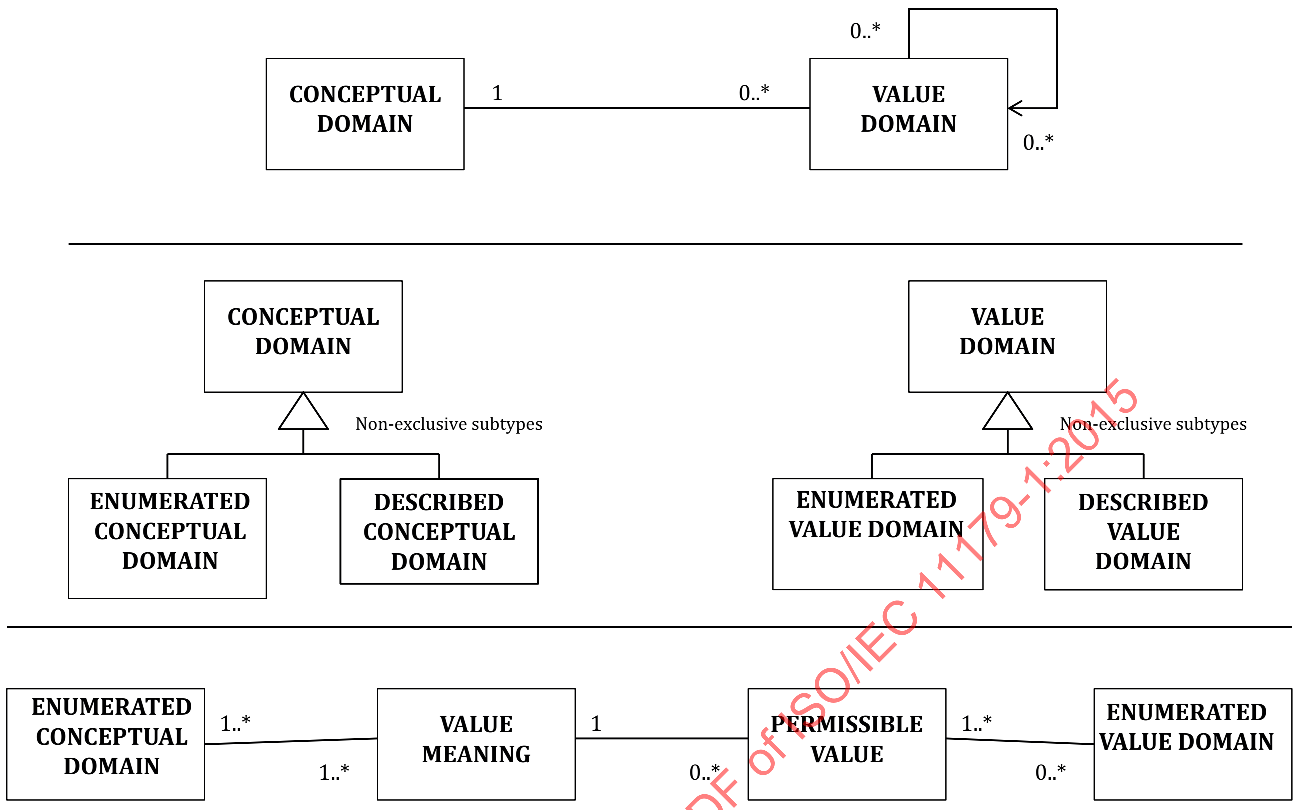


Figure 2 — Fundamental model of value domains

Value domains come in two (non-exclusive) sub-types:

— **Enumerated value domain**,

— **Described value domain**.

An enumerated value domain contains a list of all its permissible values. A described value domain is specified by a description. The **described value domain description** describes precisely which permissible values belong and which do not belong to the value domain. An example of a description is the phrase “Every real number greater than 0 and less than 1 represented as decimals in Arabic numerals”.

A **conceptual domain** is a set of value meanings. Each value domain is linked to a conceptual domain in the following way: the value meaning from each permissible value in the value domain is one of the value meanings in the linked conceptual domain. The intension of a conceptual domain is its value meanings. Many value domains may be linked to the same conceptual domain, but a value domain is associated with one conceptual domain. Conceptual domains may have relationships with other conceptual domains, so it is possible to create a concept system of conceptual domains. Value domains may have relationships with other value domains, which provide the framework to capture the structure of sets of related value domains and their associated concepts.

Conceptual domains, too, come in two (non-exclusive) sub-types:

— **Enumerated conceptual domain**,

— **Described conceptual domain**.

The value meanings for an enumerated conceptual domain are listed explicitly. This conceptual domain type corresponds to the enumerated type for value domains. The value meanings for a described conceptual domain are expressed using a rule, called a **described conceptual domain description**. Thus, the value meanings are listed implicitly. This rule describes the meaning of permissible values in a described value domain. An example of a description is the phrase "Every real number greater than 0 and less than 1". This conceptual domain type corresponds to the described type for value domains. See ISO/IEC/TR 20943-3 for detailed examples.

A unit of measure is sometimes required to describe data. If temperature readings are recorded in a database, then the temperature scale (e.g., Fahrenheit or Celsius) is necessary to understand the meaning of the values. Another example is the mass of rocks found on Mars, measured in grams. However, units of measure are not limited to physical quantities, as currencies (e.g., US dollars, Euros, British pounds) and other socio-economic measures are units of measure, too.

Some units of measure are equivalent to each other in the following sense: Any quantity in one unit of measure can be transformed to the equal quantity in another unit of measure. All equivalent units of measure are said to have the same dimensionality. For example, currencies all have the same dimensionality. Measures of speed, such as miles per hour or meters per second, have the same dimensionality. Two units of measure that are often erroneously seen as having the same dimensionality are pounds (as in weight) and grams. A pound is a measure of force, and a gram is a measure of mass.

A unit of measure is associated with a value domain, and the dimensionality is associated with the conceptual domain.

Some value domains contain very similar values from one domain to another. Either the values themselves are similar or the meanings of the values are the same. When these similarities occur, the value domains may be in the extension of one conceptual domain. The following examples illustrate this and the other ideas in this sub-clause:

EXAMPLE 1 Similar described value domains

Conceptual domain name: Probabilities

Conceptual domain definition: Real numbers greater than 0 and less than 1.

Value domain name (1): Probabilities – 2 significant digits

Value domain description: All real numbers greater than 0 and less than 1 expressed in Arabic decimal numerals and represented with 2-digit precision.

Unit of measure precision: 2 digits to the right of the decimal point

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Value domain name (2): Probabilities – 5 significant decimal digits

Value domain description: All real numbers greater than 0 and less than 1 expressed in Arabic decimal numerals and represented with 5-digit precision.

Unit of measure precision: 5 digits to the right of the decimal point

EXAMPLE 2 Similar enumerated value domains

Conceptual domain name: Naturally Occurring Chemical elements

Conceptual domain definition: Chemical elements found in nature

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Value domain name (1): Naturally Occurring Element Names

Permissible values:

< Hydrogen, Class of atoms with one proton in the nucleus >

< Helium, Class of atoms with two protons in the nucleus >

...

< Uranium, Class of atoms with 92 protons in the nucleus >

Value domain name (2): Naturally Occurring Element Symbols

Permissible values:

< H, Class of atoms with one proton in the nucleus >

< He, Class of atoms with two protons in the nucleus >

...

< U, Class of atoms with 92 protons in the nucleus >

Every value domain represents two kinds of concepts: data element concept (indirectly) and conceptual domain (directly). The *Data Element Concept* is the concept associated with a data element. The value domain is part of the representation for the data element, and, therefore, indirectly represents the data element concept, too. However, the value domain is directly associated with a conceptual domain, so represents that concept, independent of any data element.

See ISO/IEC/TR 20943-3 for detailed examples about the registration and management of value domains.

5.6 Fundamental model of concept systems

For the purposes of ISO/IEC 11179 (all parts), a **classification scheme** is a concept system intended to classify objects. It is organized in some specified structure, limited in content by a scope, and designed for assigning objects to concepts defined within it. Concepts are assigned to an object, and this process is called classification. The relationships linking concepts in the concept system link objects that the related concepts classify. In general, any concept system is a classification scheme if it is used for classifying objects.

Figure 3 illustrates the fundamental model of concept systems.

Concept systems consist of concepts and relations among the concepts. The relations are a kind of concept, and they are types for the relationships that are established among particular sets of concepts. In ISO/IEC 11179-3, the relationships between concepts in a concept system are called links. Concept systems, and classification schemes in particular, can be structured in many ways. The structure is defined by the types of relationships that may exist between concepts.

A special kind of concept system is a relationship system. The statement "a set of N objects is classified by an n-ary relation" means that the N objects have a relationship among them of the given relationship type, where the relationship of that type takes N arguments.

The content scope of the classification scheme circumscribes the subject matter area covered by the classification scheme. The scope of the classification scheme is the broadest concept contained in the concept system of the scheme. It determines, theoretically, whether an object can be classified within that scheme or not.

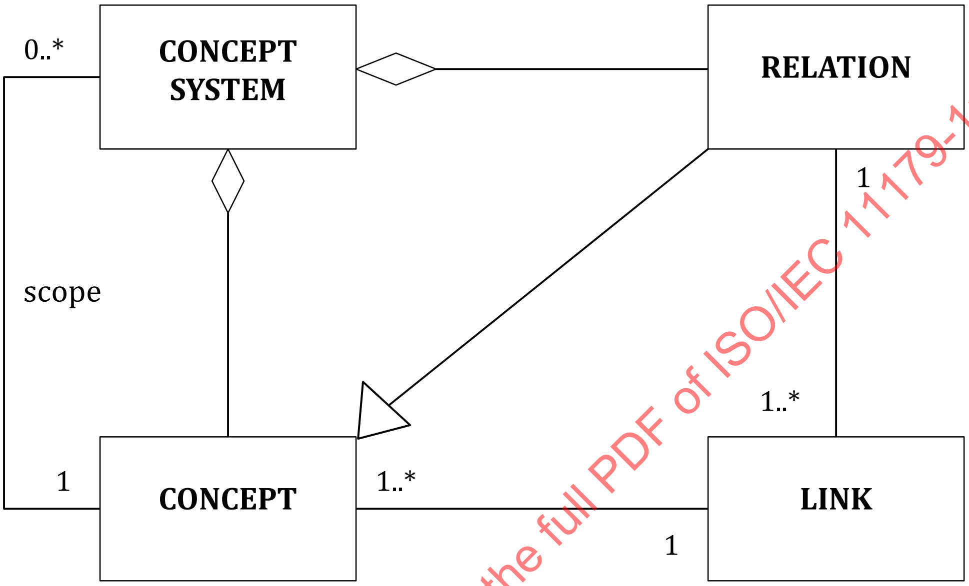

Figure 3 — Fundamental model of concept systems

A classification scheme can be used for the purpose of linking concepts to objects. In a particular classification scheme, the linked concepts together with other concepts related to each linked concept in the scheme provide a conceptual framework in which to understand the meaning of the object. The framework is limited by the scope of the classification scheme.

A concept system may be represented by a terminological system. The designations are used to represent each of the concepts in the system and are used as keywords linked to objects for searching, indexing, or other purposes.

6 Metadata registries

6.1 General

Metadata are also data, so metadata might be stored in a database. A database of metadata that supports the functionality of registration is a **metadata registry** (MDR). A conceptual model of an MDR for describing data is provided in ISO/IEC 11179-3. The requirements and procedures for the ISO/IEC 11179 aspects of registration are described in ISO/IEC 11179-6. For actual metadata registries, there may be additional requirements and procedures for registration, which are outside the scope of this International Standard. Rules and guidelines for providing good definitions and developing naming conventions are described in ISO/IEC 11179-4 and ISO/IEC 11179-5, respectively. The role of classification is described in ISO/IEC 11179-2. Recommendations and practices for registering data elements are described in ISO/IEC/TR 20943-1. Recommendations and practices for registering value domains are described in ISO/IEC/TR 20943-3.

An MDR contains metadata describing data constructs. The attributes for describing a particular data construct (e.g., data elements, data element concept, conceptual domain, and value domain) are known, collectively, as a metadata object. When the attributes are instantiated with the description of a particular data construct, they are known as a metadata item. Recording the metadata item in an MDR makes it a registry item. Depending on requirements, the registry item may further be identified, named, classified, registered and/or administered. See ISO/IEC 11179-3:2013, 5.5 for details.

NOTE In common parlance, registering a metadata item describing a data construct is known as registering that data construct. Actually, the data construct is not stored in the MDR, its description is. This is analogous to the registries maintained by governments to keep track of motor vehicles. A description of each motor vehicle is entered in the registry, but not the vehicle itself. However, people say they have registered their motor vehicles, not the descriptions.

6.2 Overview model for an ISO/IEC 11179 MDR

The conceptual model for an ISO/IEC 11179 MDR contains two main parts: the conceptual level and the representational (or syntactical) level. The conceptual level contains the classes for the *data element concept* and *conceptual domain*. Both classes represent concepts. The representational level contains the classes for *data element* and *value domain*. Both classes represent containers for data values.

Clause 5 contains descriptions of each of the classes represented in Figure 4.

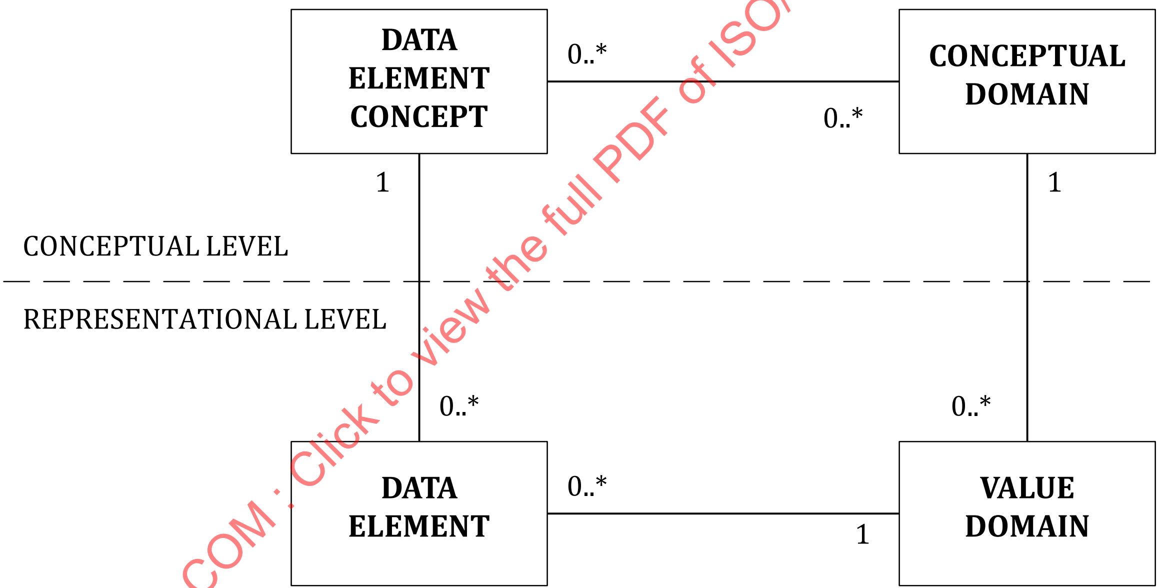

Figure 4 — Overview model for ISO/IEC 11179 Metadata Registry

Figure 4 represents several fundamental facts about the four classes:

— A data element is an association of a data element concept and a representation (primarily a value domain);

— Many data elements may share the same data element concept, which means a DEC may be represented in many different ways;

— Data elements may share the same representation, which means that a value domain can be reused in other data elements;

— Value domains do not have to be related to a data element and may be managed independently;

— Value domains that share all the value meanings of their permissible values are conceptually equivalent, so share the same conceptual domain;

