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Systems to manage terminology, knowledge and content — Concept-related aspects for developing and internationalizing classification systems

Systèmes de gestion de la terminologie, de la connaissance et du contenu — Aspects conceptuels du développement et de la localization des systèmes des classement

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 22274 was prepared by Technical Committee ISO/TC 37, *Terminology and other language and content resources*, Subcommittee SC 3, *Systems to manage terminology, knowledge and content*.

Introduction

Classifying things is a common technique humans use to cope with the complexity of the world around us. The role of classification systems in our daily life can hardly be overestimated.

Classification systems organize content in a systematic way. They are highly influenced by their respective domain-specific terminologies and can, in turn, have an effect on those domain-specific terminologies. Classification systems make domain knowledge accessible to a broad audience beyond the specialists who are directly involved in that domain. Terms are established and knowledge is systematized in classification systems.

In many cases, classification systems are used to structure large collections of data supporting functions such as data mining or information retrieval. Dictionaries, libraries or catalogues, as well as web pages or retrieval systems, are examples of data collections that may benefit from being structured by classification systems.

Classification systems allow people to communicate about topics by providing sets of concepts that help to reduce the complexity of the topic to a level which is manageable for their users. These concepts allow us to direct the information flow within or between software applications, to communicate with experts from different domains or to communicate with people of different backgrounds.

If the classification system is to be used in more than one linguistic community, it needs to be localized to account for the languages, social conventions, and cultures of its users. To facilitate localization, the classification system needs to be designed so that it is clear, easy to use, and otherwise prepared to be localized.

This International Standard provides advice on how to design classification systems and how to express their content so that they are adaptable to different linguistic environments. This International Standard complements existing documents, e.g. ISO/IEC˚Guide˚77,[19] ISO 13584,[9] IEC 61360,[18] ISO 22745,[15] and ISO/IEC 11179.[7]

Systems to manage terminology, knowledge and content — Concept-related aspects for developing and internationalizing classification systems

1 Scope

This International Standard establishes basic principles and requirements for ensuring that classification systems are suitable for worldwide application, considering such aspects as cultural and linguistic diversity as well as market requirements. By applying principles relating to terminology work, this International Standard provides guidelines for creating, handling, and using classification systems for international environments.

This International Standard addresses the need in many domains for classification systems that are concept based to ensure that they are suitable for worldwide use and can be adapted to specific user communities. It provides information about the design, development, and use of classification systems that are fully enabled for diverse linguistic, cultural, and market-based environments.

This International Standard primarily specifies the factors that need to be considered when creating and populating a classification system for use in diverse linguistic environments. These factors include the specification of principles for incorporating internationalization aspects into classification systems, and maintaining and using those aspects for the structuring of activities, products, services, agents, and other entities of a company or organization.

The following are within the scope of this International Standard:

a) guidelines on information content to support internationalization of classification systems and their underlying concept systems;

b) terminological principles applicable to classification systems;

c) requirements for internationalization of classification systems;

d) considerations on workflow and administration of classification system content to support worldwide use.

The following are outside the scope of this International Standard:

— providing formal data models for representing classification systems in machine-readable form;

— prescribing classification system content for specific business domains or products;

— harmonization of classification systems.

This International Standard is intended for those who develop content for classification systems. This includes terminologists and content managers who are called upon to apply the principles of terminology work to ensure that cultural and linguistic diversity are appropriately reflected in classification systems. It is also relevant for people who design and model appropriate IT tools.

NOTE Formal data models for implementation of classification systems in information technology environments can be obtained from technical committees such as ISO/TC 184 or IEC/TC 3.

2 Normative references

The following referenced documents are indispensable for the application 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 1087-1:2000, *Terminology work — Vocabulary — Part 1: Theory and application*

ISO/IEC 6523 (all parts), *Information technology — Structure for the identification of organizations and organization parts*

ISO/IEC 15418, *Information technology — Automatic identification and data capture techniques — GS1 Application Identifiers and ASC MH10 Data Identifiers and maintenance*

ISO/IEC 15459-6, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 6: Groupings*

ISO/TS 29002-5, *Industrial automation systems and integration — Exchange of characteristic data — Part 5: Identification scheme*

ISO/IEC Directives, Supplement:2012, *Procedures specific to IEC*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1087-1 and the following apply.

3.1
associative relation
relation between two **concepts** (3.7) having a non-hierarchical thematic connection by virtue of experience

EXAMPLE An associative relation exists between the concepts "education" and "teaching" or "baking" and "oven".

[SOURCE: ISO 1087-1:2000, 3.2.23, modified]

3.2
attribute
data element for the computer-sensible description of a **property** (3.25), a relation or a **class** (3.4)

[SOURCE: ISO/IEC Guide 77-2:2008, 2.2]

EXAMPLE Creation date of a class **object** (3.22) in a computer system.

3.3
characteristic
distinguishing feature

NOTE 1 A characteristic can be inherent or assigned.

NOTE 2 A characteristic can be qualitative or quantitative.

NOTE 3 There are various **classes** (3.4) of characteristic, such as the following:

— physical (e.g. mechanical, electrical, chemical or biological characteristics);

— sensory (e.g. related to smell, touch, taste, sight, hearing);

— behavioural (e.g. courtesy, honesty, veracity);

— temporal (e.g. punctuality, reliability, availability);

— ergonomic (e.g. physiological characteristic or related to human safety);

— functional (e.g. maximum speed of an aircraft).

[SOURCE: ISO 9000:2005, 3.5.1]

NOTE 4 Characteristics that apply to **concepts** (3.7) are called **features** (3.12), whereas characteristics of **classes** (3.4) are called **properties** (3.25).

EXAMPLE Figure 1 shows the interrelation of the items **concept** (3.7), **feature** (3.12), **class** (3.4), **attribute** (3.2), and **property** (3.25). The figure shows sections of a **concept system** (3.8) and a **classification system** (3.6). The class "Car" is derived from the concept "Motor vehicle" and the property "Colour" implements the feature "Pigmentation". The class "Car" has attributes such as "Preferred name" and "Definition". The concept "Automobile" is not used in the classification system.

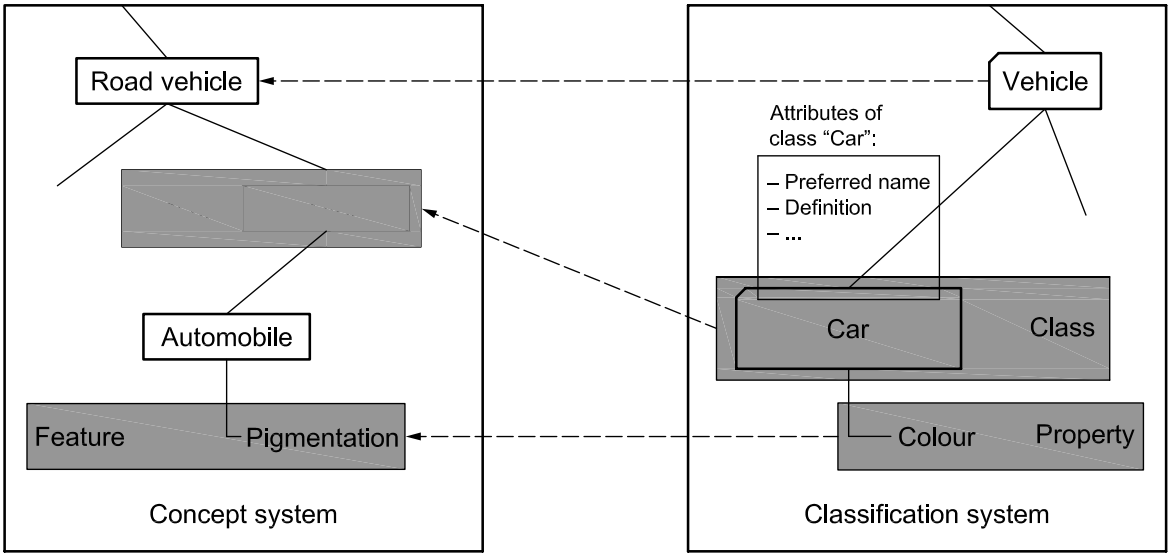

Figure 1 — Interrelation of concept (3.7), feature (3.12), class (3.4), attribute (3.2), and property (3.25)

3.4
class
description of a set of **objects** (3.22) that share the same **characteristics** (3.3)

NOTE The characteristics may be embodied by the use of properties, operations, methods, relations, semantics, etc.

3.5
classification
process of assigning **objects** (3.22) to **classes** (3.4) according to criteria

3.6
classification system
systematic collection of **classes** (3.4) organized according to a known set of rules, and into which **objects** (3.22) may be grouped

NOTE This International Standard considers both classification systems with properties and classification systems without properties.

EXAMPLE 1 The United Nations Standard Products and Services Code (UNSPSC) is an example of a classification system without properties.

EXAMPLE 2 IEC 61360-4-DB[18] is an example of a classification system with properties.

3.7
concept
unit of knowledge created by a unique combination of **characteristics** (3.3)

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

NOTE Concepts are not necessarily bound to particular languages. They are, however, influenced by the social or cultural background which often leads to different **classifications** (3.5).

3.8
concept system
set of **concepts** (3.7) structured according to the relations among them

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

3.9
extension
totality of **objects** (3.22) to which a **concept** (3.7) corresponds

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

3.10
facet
group of **classes** (3.4) or **concepts** (3.7) of the same inherent category

[SOURCE: ISO 25964-2:—,[16] 3.32, modified]

EXAMPLE 1 High-level categories that can be used for grouping concepts into facets are: **objects** (3.22), materials, agents, actions, places and items.

NOTE Facets used in **classification systems** (3.6) should follow the rules given in 5.4, whereas facets used in **concept systems** (3.8) are free from such restrictions. In either case, the recommendations given in 5.3 should apply.

EXAMPLE 2 Facets of a **classification system** (3.6) for commodities may be functional view, product-oriented view, material, maintenance considerations or logistics.

3.11
faceted classification system
classification system (3.6) where **classes** (3.4) are grouped in mutually exclusive and collectively exhaustive aspects that can be combined to specify complex subjects

EXAMPLE Classes to specify programmable logic controllers may be grouped in **facets** (3.10) such as "technology", "programming", "packaging", and "accounting".

3.12
feature
defined **characteristic** (3.3) suitable for the description and differentiation of **concepts** (3.7) in a **concept system** (3.8)

3.13
general concept
concept (3.7) which corresponds to two or more **objects** (3.22) which form a group by reason of common **characteristics** (3.3)

EXAMPLE "Planet" or "tower".

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

3.14
generic relation
relation between two **concepts** (3.7) where the **intension** (3.15) of one of the **concepts** (3.7) includes that of the other **concept** (3.7) and at least one additional delimiting **characteristic** (3.3)

[SOURCE: ISO 1087-1:2000, 3.2.21, modified]

3.15
intension
set of **characteristics** (3.3) of a **concept** (3.7)

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

3.16
internationalization
process whereby products and services are implemented in a way that allows for and facilitates the adaptation to local languages and cultural conventions

NOTE Internationalization is a prerequisite for a systematic approach to **localization** (3.21).

3.17
leading locale
locale (3.20) in or for which a product or service is developed and which serves as a reference point for further **localization** (3.21)

3.18
leaf class
class (3.4) in a hierarchical **classification system** (3.6) which has one or more superordinate classes and no subordinates

3.19
level
magnitude of a quantity considered in relation to a reference value

3.20
locale
unique combination of parameters specifying the language, geographic area, and other cultural, administrative or technical preferences of a given community

3.21
localization
adaptation of a product or communication to a community of speakers with respect to cultural, linguistic, legal, political and technological factors

[SOURCE: ISO/TR 22134:2007,[14] 3.7]

3.22
object
anything perceivable or conceivable

NOTE Objects may be material (e.g. an engine, a sheet of paper, a diamond), immaterial (e.g. conversion ratio, a project plan) or imagined (e.g. a unicorn).

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

3.23
partitive relation
relation between two **concepts** (3.7) where one of the concepts constitutes the whole and the other concept a part of that whole

NOTE A partitive relation exists between the concepts “week” and “day” or “molecule” and “atom”.

[SOURCE: ISO 1087-1:2000, 3.2.22, modified]

3.24
polyhierarchy
hierarchy including elements that have links to more than one parent element

3.25
property
defined **characteristic** (3.3) suitable for the description and differentiation of the **objects** (3.22) in a **class** (3.4)

EXAMPLE Ambient temperature may be a property of a class comprising geographical locations.

3.26
terminology
set of designations belonging to one special language

[SOURCE: ISO 1087-1:2000, 3.5.1]

3.27
value domain
set of permissible values

[SOURCE: ISO/IEC 11179-1:2004,[7] 3.3.38]

3.28
vocabulary
terminological dictionary which contains designations and definitions from one or more specific subject fields

[SOURCE: ISO 1087-1:2000, 3.7.2]

4 Relations to other documents

The following documents provide guidelines about fundamentals applicable to the development of classification systems and to other related tasks.

— ISO 704[1] defines the essential elements for quality in terminology work.

— ISO 1087-1 defines fundamental terminological concepts.

— ISO/TS 29002-5 specifies elements and syntax of identifiers of elements of a concept dictionary.

— IEC 61360,[18] ISO 13584[9] or ISO 22745[15] specify data models that may be used to store, retrieve or maintain classification systems in data-processing environments.

— Annex SL, *Procedures for the maintenance of the IEC standards in database format*, in: ISO/IEC Directives, Supplement:2012, describes procedures applicable for the maintenance of International Standards comprising classification systems managed in a data-processing environment.

5 Fundamental development considerations for classification systems

5.1 General

Classification systems are widely used to facilitate handling and interpretation of objects by organizing the knowledge of an area of discourse and thus provide the information needed to unambiguously characterize those objects. To serve this purpose, classification systems should be carefully designed to avoid structures that do not provide the requested information or that are overly complicated, which confuses users. The development of a sound classification hierarchy is facilitated if it reflects an underlying concept system that shall be elaborated based on recognized principles for managing terminology. Through a mapping process, the concepts in the concept system become classes in the classification system.

Often the criterion of classification is likeness. A classification unites like things and it separates unlike things. Things may, however, be alike in many different ways. A classification should unite things from

a functional or a pragmatic point of view based on the purpose of the classification. The objects to be classified may be things, persons, processes, ideas, services, and so forth.

5.2 Application domains

Classification systems are developed for many domains. They are used in domains such as:

— healthcare;

— manufacturing;

— service delivery;

— documents and libraries;

— science;

— retail.

Examples 1 to 8 describe sample classification systems from each of these domains.[1)]

EXAMPLE 1 The Global Medical Device Nomenclature (GMDN) is an important classification system for medical devices. All parties involved with medical devices, such as manufacturers, regulators, conformity assessment bodies, traders, owners, and users, have a common interest in having access to an unambiguous classification of those devices, including clear definitions and terms. Processes addressed by GMDN include:

— manufacturing;

— registration;

— incident reporting;

— trading;

— inventory, stock-keeping, and life-cycle information.

EXAMPLE 2 eCl@ss® (Reference [32]) is an international industry standard for classification of products, materials, and services. In addition to providing the option of describing each individual product in a unique way, eCl@ss® provides codes to specify product groups. Purchasers and consumers can identify products and services with the eCl@ss® codes when they are using product databases, merchandise information systems or electronic catalogues.

EXAMPLE 3 The International Standard Industrial Classification (ISIC) is an international reference classification of activities within production processes. Its main purpose is to provide a set of activity categories that can be utilized for the collection and reporting of statistics according to such activities. Since the original version in 1948, ISIC has provided guidance to countries for developing national activity classifications and has become an important tool for comparing statistical data on economic activities at the international level.

EXAMPLE 4 The Universal Decimal Classification (UDC) is a multilingual classification scheme for all fields of knowledge, a sophisticated indexing and retrieval tool for organizing bibliographic records for all kinds of information in any medium. It was adapted from the Dewey Decimal Classification (DDC) and first published (in French) between 1904 and 1907.

EXAMPLE 5 The London Classification of Business Studies (LCBS) was compiled as a result of rapid expansion in the field of management education following the establishment of two graduate business schools in the UK (London and Manchester) in 1965. It has an international reputation and is used in many business libraries and information services throughout the world.

EXAMPLE 6 The Library of Congress Classification (LCC) is a classification system that was first developed in the late 19th and early 20th century to organize the book collections of the Library of Congress. Over the course of the 20th century, the system was adopted for use by other libraries as well, especially large academic libraries in the USA and in research and academic libraries in other countries.

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1) The Global Medical Device Nomenclature (GMDN), eCl@ss®, The Physics and Astronomy Classification Scheme® (PACS®), GS1®, and GSDN® are examples of suitable services available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these services.

EXAMPLE 7 The Physics and Astronomy Classification Scheme® (PACS®) is designed to categorize the literature of physics and astronomy. PACS® is used by international publishers of journals in physics, astronomy, and related fields.

EXAMPLE 8 The Global Product Classification (GPC) is the classification system of GS1® (Reference [22]) representing users in more than 20 activity sectors. GPC currently classifies 36 product category segments. GPC is mandatory in the Global Data Synchronisation Network (GDSN®) and fully in line with the GS1® system.

5.3 Generic requirements

5.3.1 Consistency

A key requirement on classification systems is consistency. Classes shall be clearly separated from each other and their individual areas of applicability shall not overlap. Especially in cases when processing by information technology is envisaged, a clear structure and the absence of ambiguities is a requirement. Definitions shall clearly identify the specific concepts that make up the various classes.

The terms used to name the classes as well as those used in the definitions of classes and any other information in the classification system shall be consistent. A consistent terminology provides the basis for an unambiguous communication between users as well as between software applications.

5.3.2 Comprehensibility

The rules for creating classes and for writing definitions shall be documented and made available for users and providers of content. Clear definitions of the concepts employed in the classification system make it more comprehensible and reduce ambiguities. The levels of the classification system and their divisions into individual classes shall be explicitly defined. The criteria or rules for creating new hierarchy levels or new classes shall be documented.

5.3.3 Extensibility

Extensibility is the ability to accommodate new classes at their correct place in the classification system. Classes shall be created in a level or position in the hierarchy that reflects their relations to existing classes. Classification systems shall be extensible so that they can accommodate new requirements or perspectives within their area of applicability.

5.4 Structuring principles

5.4.1 General

Even though most of the existing classification systems do not exclusively apply one of the approaches described below, but are a blend of them, the following main principles can be identified:

— enumerative;

— faceted;

— enumerative and faceted (with entry class).

There is no generic rule on the structure of a classification system. The decision has to be made on a case-by-case basis in accordance with the requirements that result from the intended area of application. This includes subjects such as:

— structuring principle;

— use of properties (mandatory or optional);

— properties at any level or properties at leaf level only.

Additionally, changes of already existing structures may become necessary during the lifetime of a classification system.

5.4.2 Enumerative classification systems

Enumerative classification systems attempt to list all possible subjects within their defined area of applicability. They are in many cases represented by using hierarchies. Nevertheless, in some cases enumerative schemes may be represented by simple unstructured sets of objects.

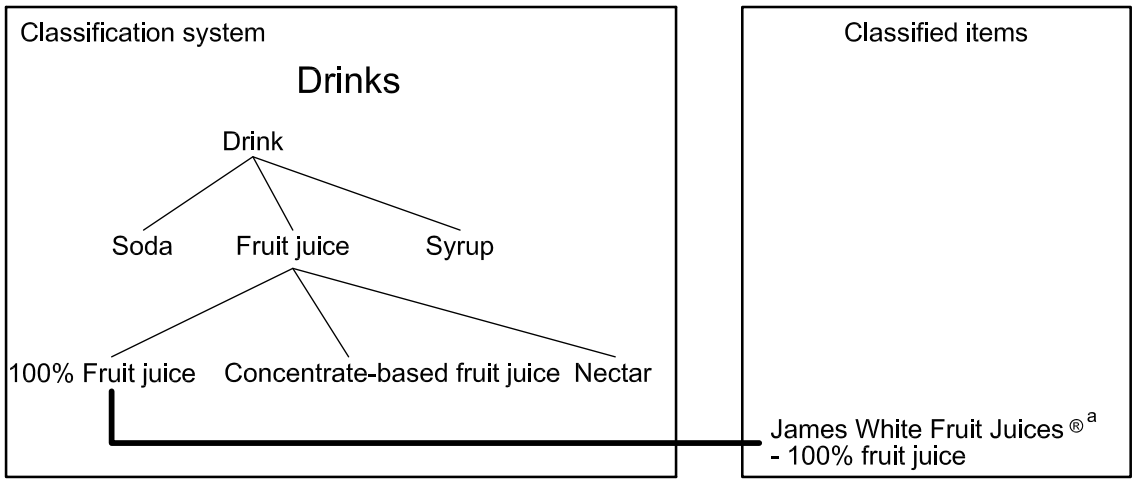
NOTE 1 See Reference [26] for an in-depth treatment of enumerative classification systems.

The hierarchy utilizes a "top down" approach, a process of division producing a series of classes in successive subordination. Thus, the number of subclasses of any class may require a limitation for ease of handling by the intended users of the classification system.

NOTE 2 Successive subordination of classes creates a hierarchical structure of the classification system. Thus, enumerative classification systems are also referred to as hierarchical classification systems.

NOTE 3 In enumerative classification systems, a subject can only be classified if it is explicitly covered by the area of applicability of one of the classes in the classification system. Enumerative classification systems can, therefore, require a higher number of classes than faceted classification systems, because for each class all possible combinations of constituent characteristics require representation. Additionally, it is possible for constituent characteristics such as "unfinished" to require frequently repetition. Thus, an enumerative classification system tends to become a compromise between the number of its classes and its completeness. A complete enumerative classification system is often very complex in nature and its basic principles of construction are difficult to identify.

NOTE 4 Such classification systems often include general classes such as "Miscellaneous" for classes that do not precisely fit into a more specifically named class.



Key

_____ Generic relation

NOTE This figure is for illustrative purposes only. It is not intended to be a valid classification system for the domain of drinks.

[a] Product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

Figure 2 — Example of an enumerative classification system

5.4.3 Faceted classification systems

Faceted classification systems allow the assignment of multiple classifications to an object. An object may be characterized by any combination of the classes from the facets.

The statement “In faceted classification systems an entry class common to all facets does not exist” should be moderated by indicating that such an entry class may be difficult to reach. However, for a given purpose, it may be possible to have an “entry class” that permits response to market needs.

See Reference [26] for an in-depth treatment of faceted classification systems.

In general, faceted classification systems need fewer classes to express a certain variety of objects than enumerative classification systems. A difficulty may be the need to avoid absurd combinations of classes.

The classes within the facets may be arranged to form single level or multilevel hierarchies.

Faceted classification systems take advantage of the fact that in many domains the classes of a classification system share certain types of characteristics. Such shared characteristics may be grouped together into facets. The facets shall be orthogonal, i.e. their areas of application shall not overlap.

In faceted classification systems, an entry class common to all facets is not required. However, the need for an entry class may arise for ease of use of the classification system. All facets taken together make up the classification system and, thus, share its area of applicability. Conversely, a faceted classification system shall be regarded as inconsistent if any of its facets are removed.

NOTE 1 Many subjects in modern technology are extremely rich of variants. In such cases, the use of an enumerative approach would lead to classification systems of unmanageable size. Thus, the faceted approach helps to reduce the size of the classification system and to keep it user friendly.

NOTE 2 Even though the various facets are independent from each other (orthogonal), they belong to the same classification system and thus all share the area of applicability of their classification system. Using them independently from each other can lead to inconsistencies.

EXAMPLE 1 The configuration of a modern luxury car comprises, literally, millions of variants. To keep the ordering systems user-friendly, a faceted approach is used where the customer can independently choose from different aspects such as colour, motor power or interior design.

The faceted approach may be restricted to the properties of the classes within a classification system. In such cases, classes within an enumerative class structure may be qualified by various sets of properties.

EXAMPLE 2 Classification systems for industrial products can include multiple facets comprising generic sets of characteristics for identification purposes, material specification, life-cycle information, etc.

EXAMPLE 3 A notation in Colon Classification (CC) uses facets. As an example of the use of facets in CC, the classification of a complex subject is shown. To classify the subject “Design of submarines in the USA in the 20th century” the classifier would first analyse the subject into its separate components: central concept (submarine), process (design), place (USA), time (20th century). Next, the classification system would be consulted to discover the notation for each of these concepts. These notational elements would then be combined to form the complete notation. Thus, the facets would receive the following notations:

“D5254” Submarine (D is main class engineering, 5254 represents submarine);

“4” Design in class D (engineering);

“73” USA;

“N” 20th century.

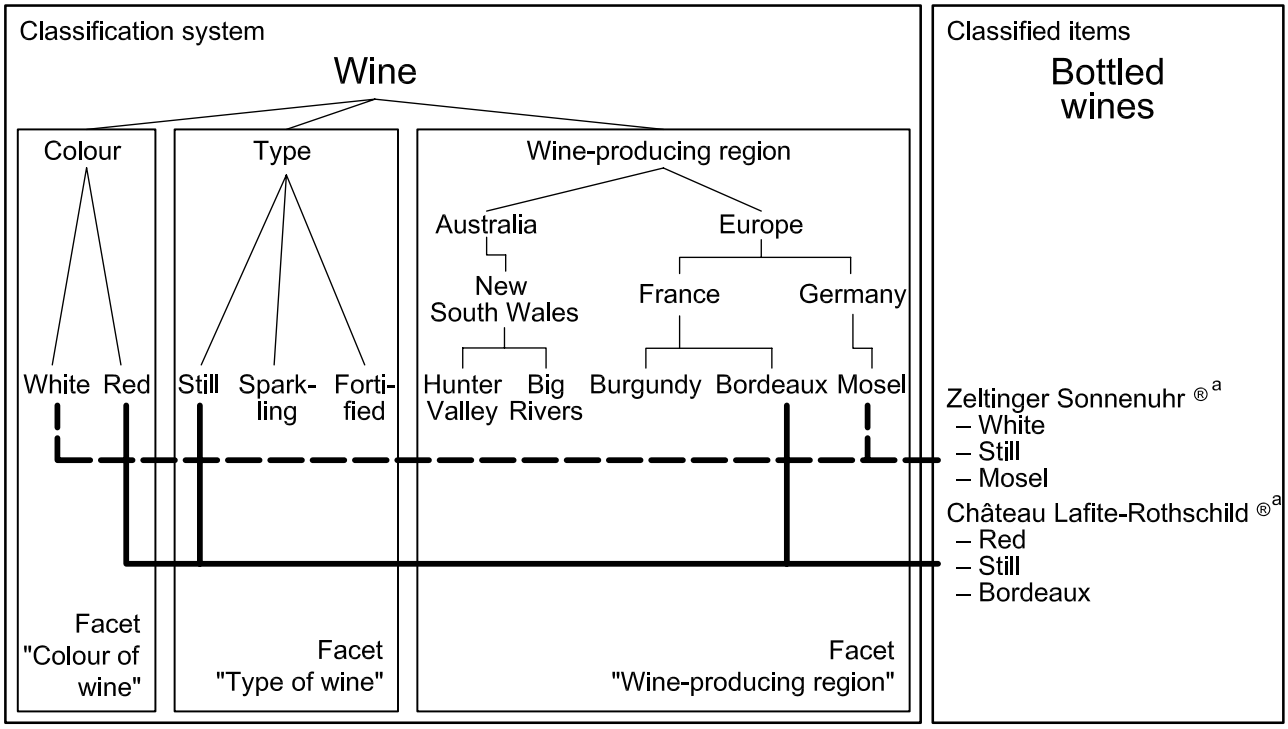
The complete notation, including the linking symbols, is: ”D5254:4.73’N” (Reference [26]).

EXAMPLE 4 The UDC is currently revising its class 1 “Philosophy”. One step in the revision is to identify the facets needed to express the contents of philosophical knowledge appropriately.

The following facets of philosophy have been identified (Reference [24]):

Branches. Fields;
Systems. Schools. Traditions. Periods. History;
Viewpoints. Standpoints. Doctrines. Approaches. Theories. Philosophical attitudes. System typology. Isms;
Topics. Special philosophies. Domain philosophies. Philosophy of special subjects;
Development. Interactions;
Practice. Method. Argumentation;
Applications. Applied philosophy;
Philosophers. Promoters. Person and vocation of the philosopher;
Sources. Materials.

EXAMPLE 5 A faceted classification system can have general facets which are applicable to any main class of the classification system such as the facets of Time and Place.



Key

_____ Generic relation ┌┴┐ Partitive relation

NOTE This figure is for illustrative purposes only. It is not intended to be a valid classification system for the domain of wines.

[a] Product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

Figure 3 — Example of a faceted classification system

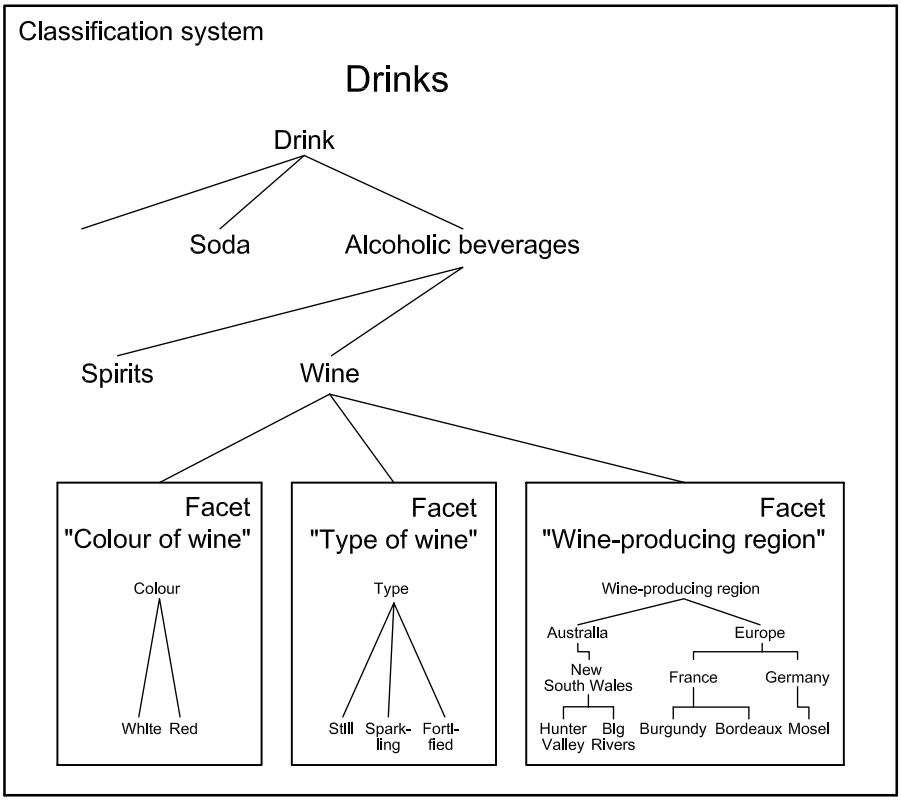
5.4.4 Enumerative and faceted classification systems

A combination of the enumerative and faceted approaches is advantageous in many cases. The higher levels of the classification system may follow an enumerative approach to narrow down the areas of applicability of the individual classes to a manageable size. At the lower level, faceted approaches are applied to clearly specify the nature of the concepts contained in the leaf classes of the classification system.

In contradiction to the purely faceted classification systems, the facets that, taken together, make up a branch of the classification system share a common entry class.

EXAMPLE 1 In Figure 4 "Wine" serves as entry class for the faceted branch of the "Drinks" classification system.

EXAMPLE 2 The UDC is based on an enumerative classification (Dewey Decimal Classification), but has many facets which complement the main structures.



Key

——— Generic relation ⊢ Partitive relation

NOTE This figure is for illustrative purposes only. It is not intended to be a valid classification system for the domain of wines.

Figure 4 — Example of an enumerative and faceted classification system

5.4.5 Classes and properties in classification systems

All classes within classification systems are based on characteristics, but the characteristics may or may not be explicitly expressed. Explicitly expressed characteristics are called properties. Thus, it may be said that a classification system in which the characteristics are not explicitly expressed does not have properties. See Figure 5.

EXAMPLE 1 ISO 13584-42:2010[9] specifies a data model for classification systems with enumerative structure that can carry properties at any level.

The classes in classification systems may or may not be specified by explicit class definitions. Class definitions are typically expressed in unstructured natural language. If the classification system does not have properties, the differences between classes may be solely derivable from class identifiers, from the position of the class in the classification system or, sometimes, by interpreting the class definitions.

In classification systems that do have properties, each class is accompanied by a set of properties that are expressed in a structured manner. Thus, the areas of applicability of the classes may be derived from their properties. Because they are structured, the properties are machine interpretable, which facilitates automated processes, such as search and cataloguing. Additionally, these classification systems may have class definitions expressed in natural language. The definition of a class and its class properties shall be consistent, i.e. the properties of a class shall not contradict its definition.

In classification systems with properties, properties are associated with some or all classes. Often those classification systems are structured by generic relations to allow for inheritance. The application of inheritance makes it possible to significantly reduce the number of property definitions by permitting the sharing of properties within the subtrees of the hierarchy.

EXAMPLE 2 Figure 6 shows an example of a classification system without properties.

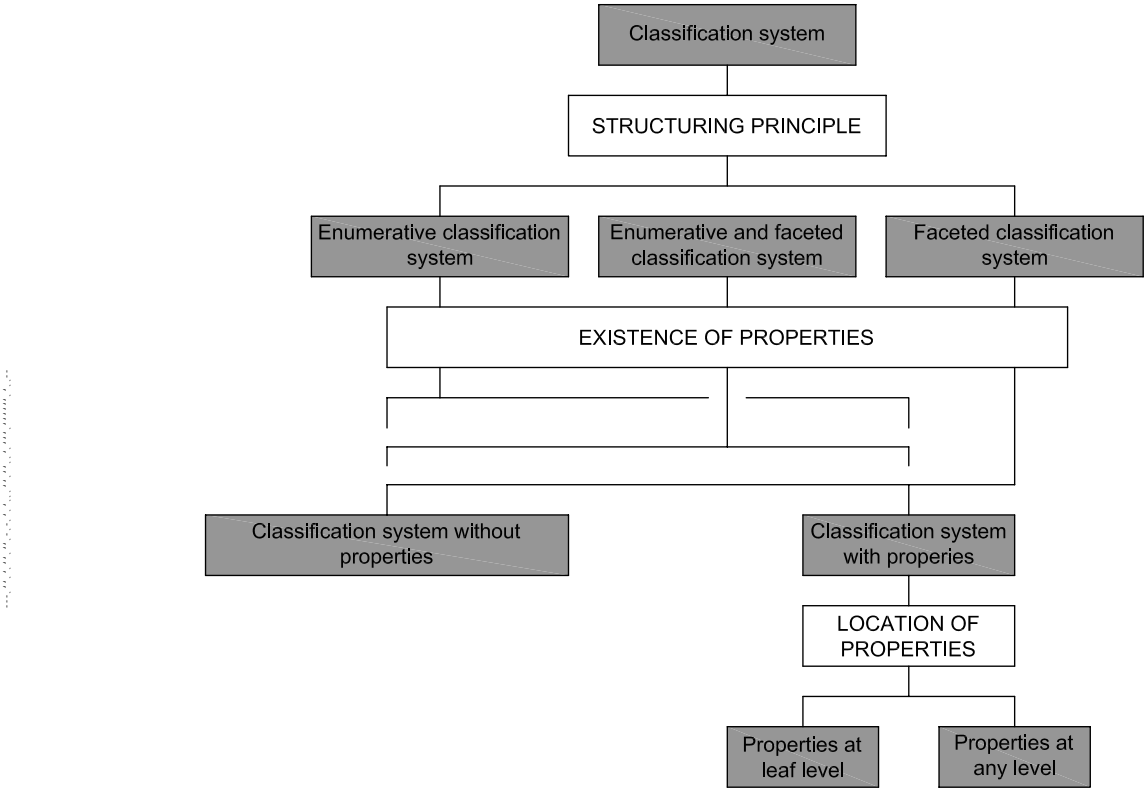
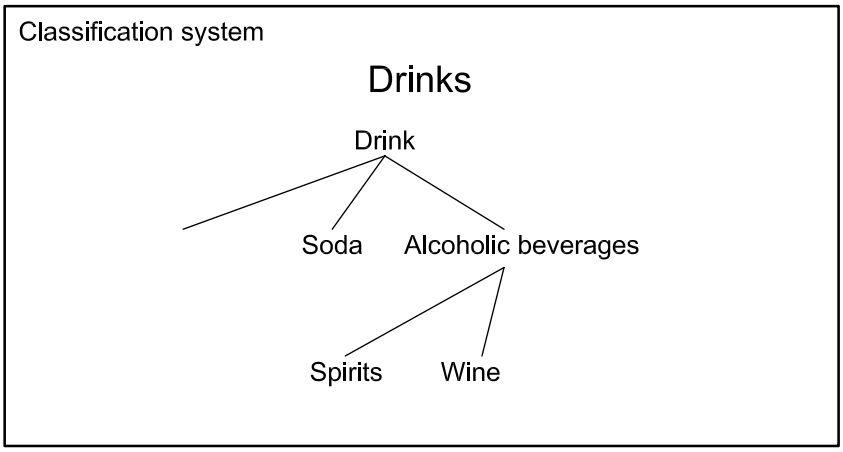


Figure 5 — Properties in classification systems



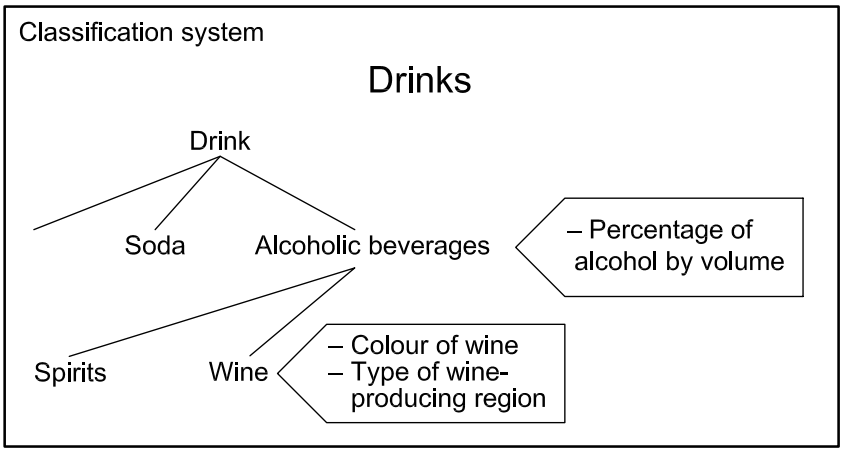
Key

_____ Generic relation

NOTE This figure is for illustrative purposes only. It is not intended to be a valid classification system for the domain of drinks.

Figure 6 — Example of a classification system without properties

EXAMPLE 3 Figure 7 shows an classification system where the property "Percentage of alcohol by volume" is passed down to the subordinate classes of "Alcoholic beverages".



Key

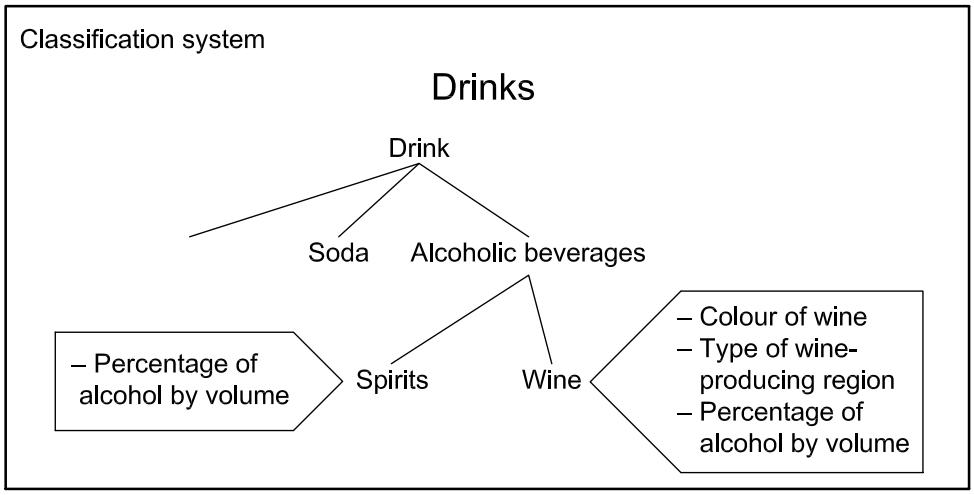
_____ Generic relation

Properties

Figure 7 — Classification system with properties allowed at any class

Classification systems that restrict the use of properties to the leaf level do not benefit from the reduction of properties by application of inheritance mechanisms.

EXAMPLE 4 Figure 8 shows a classification system where properties are only assigned to the leaf elements. Thus, the property "Percentage of alcohol by volume" has to be replicated at the class "Spirits".



Key

Generic relation

Properties

Figure 8 — Classification system with properties allowed only at leaf classes

5.4.6 Relations in classification systems

For the purpose of designing classification systems, two types of relations between classes are significant:

— generic relations;

— partitive relations.

Generic relations build hierarchies of classes by successive subordination from the most generic class down to the most specialized classes. This process is supported by the mechanism of inheritance, whereby subordinate classes always inherit the relations and rules from their superordinate class. Thus, subordinate classes are included in the intention of their immediate superordinate class. It is possible for a class to have more than one superordinate class. Such situations are called 'polyhierarchy'. In cases where polyhierarchy occurs the superordinate classes shall have no overlapping areas of applicability, i.e. no class shall fall simultaneously into the areas of applicability of both classes and, thus, be a member of both of them. Otherwise, ambiguities may occur in the subordinate classes when inheriting contradictory information about items that are inconsistently specified in the superordinate classes.

EXAMPLE 5 See Figure 9 for a simplified example of polyhierarchy. The class "Electric drive" is a piece of mechanical machinery as well as of electrical equipment.

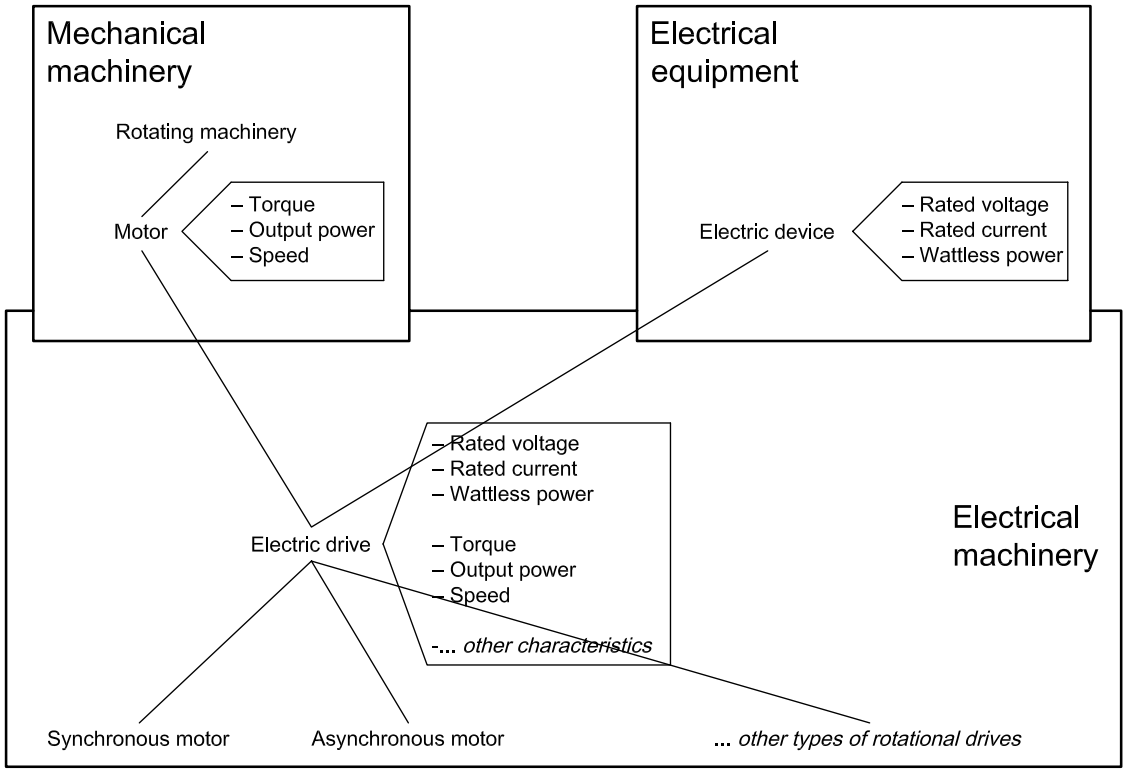


Figure 9 — Simplified example of polyhierarchy

NOTE The hierarchy of classes can be developed top down or bottom up. The successive subordination does not require any sequence of the steps that are to be followed during the design of a classification system.

Partitive relations express part–whole relations, i.e. a subordinate class is part of its superordinate class. Inheritance does not apply to partitive relations.

5.5 Descriptive requirements

5.5.1 General

Classification systems have a wide range of possible uses (see 5.2). Thus, information shall be provided concerning the intended use and any limitations regarding the purpose of the classification system. Information on structure and maintenance procedures shall also be provided. The different types of background information that shall be provided for internationalizing classification systems are specified in 5.5.2 to 5.5.5.

Large classification systems may be designed or maintained as a joint effort of more than one group of individuals, who may come from different locations or organizations. In such cases, the types of information specified in 5.5.2 to 5.5.5 may need to be repeated for each of the groups involved. If the groups are responsible for or concerned with specific sets of classes, information about this class assignment shall be provided.

EXAMPLE See Annex A for examples of descriptive information on existing classification systems.

5.5.2 Area of applicability and purpose

The area of applicability of a classification system shall specify the domain of knowledge and the degree of specialization covered by the classification system. Domains of knowledge that are excluded from the classification system shall also be identified.

Within its area of applicability, the classification system should be exhaustive, i.e. all concepts relevant to its area of application should be addressed.

EXAMPLE 1 A typical area of applicability statement follows. "This classification system is intended to reflect all goods and services available in the market, to classify all important structural information required for this purpose, and to provide the resulting product groups. The structural information is intended to make it easier to find or classify products and to automate the information flow along all business processes, as far as possible and with minimal effort. It should be possible to classify and retrieve every good or service that can be supplied or demanded in the market in an objectively logical and unambiguous way."

The purpose of the classification system shall be clearly stated.

EXAMPLE 2 A typical purpose statement follows. "This classification system is focused on the general business functions (departmental processes) of research, development, marketing, purchasing, sales, technical planning or engineering, production, maintenance, accounting, and disposal. This classification system is intended for activities relating to procurement, statistical assessment, and logistics."

5.5.3 Leading locale

Nowadays, most commercial, academic, industrial, and research activities have some interaction with global interests and, therefore, have to take into account multilingual and multicultural environments. Typically, classification systems are either developed from the beginning to cover international requirements or are developed in relation to a particular locale. In the second case, this leading locale shall be specified in the administrative information about the classification system, to serve as reference for its interpretation by users or adapters from other locales.

5.5.4 Definition and intentions of levels

Background information about the classification system shall include information about the rules that govern the creation of new classes and new levels, and information about the meaning of the levels.

5.5.5 Other descriptive requirements

In addition to the above mentioned descriptive requirements the information listed in a) to e) shall be provided.

a) Licensing and copyright.

   The content of classification systems such as class identifiers or property names is intended to be distributed, i.e. copied, among its users. Additionally, such data are often referenced from outside of the classification system. Thus, issues such as copyright restrictions or licensing requirements that may limit the uses of a classification system or parts thereof shall be documented.

b) Identification of classification system owner.

   The organization that owns the classification system shall be recorded in the administrative information. It shall be internationally registered by means of an identification code, as specified in ISO/IEC 6523.

   If such an identification code for the organization does not exist, the organization should request a registration by ISO, otherwise the identification code cannot be kept globally unique and worldwide interpretation might suffer.

c) Contact details of classification system owner.

Information about the owner of the classification system shall be provided, including contact information (complete postal address, name, e-mail address, and telephone number of the contact person). If the owning organization has a website, the URL shall be provided.

d) Access.

1) Information shall be provided about how to access the classification system and any applications that connect to or use the classification system.

2) If the classification system is accessed via a website, the address of the website shall be indicated (uniform resource name, URN).

3) In the case of application-specific access points, the relevant access information shall be provided.

4) If none of these exist, the postal address shall be provided.

e) Maintenance.

Information about the organization responsible for maintaining the classification system or its elements shall be provided, including detailed contact information. This could be either a URN or a complete postal address and contact name or an access path to an electronic service interface. Information shall be provided about how to submit change requests.

6 Terminological principles related to classification systems

6.1 General

This clause describes general principles of terminology work that can be useful for creating and maintaining classification systems. Principles of terminology work or "terminological principles", focus on analysing concepts and assigning unambiguous designations to those concepts. Clause 7 explains how to apply those principles to classification systems.

Applying terminological principles to classification systems may not be appropriate in certain cases, such as a mature classification system that has been in use for a long time and which was not originally modelled with a concept system. Retrofitting such a classification system to a concept system could have too negative an impact on its users or could require too much effort. Aside from this case, this International Standard shows how developing a new classification system on the basis of a corresponding concept system may facilitate the development of sound classification hierarchy. In any case, whether the classification system is based on a concept system or not, generic rules from 5.3 have to be applied when the classification system is being developed.

When applying terminological principles to classification systems, it is important to clearly distinguish between concepts and classes. According to ISO 1087-1, a concept is a unit of knowledge created by a unique combination of characteristics. Each linked element in a concept system represents one concept. A class in a classification system groups like objects on the basis of properties of these objects.

The classes in a classification system may represent more than one concept.

EXAMPLE "Fire vehicle" and "ambulance" are two distinct concepts. In a classification system, however, a need can arise to create one class "Emergency vehicles", which includes both fire vehicles and ambulances.

The appropriate and accurate use of terminology is crucial for effective communication, and also to foster innovation, research and the development of ideas. To an even greater degree, this applies to content and wording used within classification systems which tend to assume the role of reference collections within specific domains. Legal documents, medical records, order catalogues, engineering specifications, and statistical reports are examples of information that require standardization at the content level, so that they can be clearly interpreted.

6.2 Terminological principles related to definitions

There are different ways to write definitions of concepts; the two most common types of definitions are "intensional" and "extensional" definitions. ISO 704[1] recommends intensional definitions as they most clearly reveal the characteristics of a concept within a concept system. Intensional definitions shall include the superordinate concept and the delimiting characteristics. The superordinate concept places the concept being defined in its proper position in the concept system. Thus, using intensional definitions to define classes can help to produce a well-structured, hierarchical classification system.

When defining classes in classification systems, extensional definitions may be useful in limited circumstances. An extensional definition lists all the subordinate concepts corresponding to the objects in the extension. In defining classes, an extensional definition would list all the types of objects allowed within the intention of the class. This kind of definition is to be used only if the number of subordinate objects to be enumerated is limited, the list of subordinate objects is complete under one criterion of subdivision, and the subordinate objects are known. Wherever possible, it is recommended that intensional definitions be used.

Defining classes with extensional definitions may lead to redundancies, since the classification system itself specifies the allowed choices by means of subordinated classes.

Extensional definitions are more frequently used to define concepts which correspond to properties. In many cases, a closed set of permissible values for the property can be presented as elements in the definition of the property. Such sets of permissible values are the basis for consistency checking when users assign values to properties.

Definitions shall reflect the relations between concepts in a concept system and be as brief and clear as possible. Therefore, they should only comprise delimiting characteristics, while supplementary characteristics may be given in, for example, additional notes.

6.3 Terminological principles related to class names

The way that classes are named can significantly impact the usability of a classification system and the effort to maintain it. Therefore, care shall be taken to use precise terms when naming classes. Users should be able to easily find the classes that they are looking for, without having to read class definitions.

ISO 704[1] mentions that the principles listed in a) to l) should be followed in forming or selecting the terms used.

a) Transparency.

   A term is considered transparent when the concept it designates can be inferred, at least partially from the term itself, without a definition or an explanation. In other words, its meaning can be deduced from its parts. For a term to be transparent, a key characteristic — usually a delimiting characteristic — is used in the formation of the term itself.

   EXAMPLE "Torque wrench" is more transparent than "monkey wrench". The torque wrench was originally invented by Mr Moncke. "Monkey wrench" is a corruption of the original name of the tool.

b) Consistency.

   The terminology of any domain should be a coherent terminological system corresponding to the concept system.

c) Appropriateness.

   Proposed terms should adhere to familiar, established patterns of meaning within a language community. Formations that cause confusion should be avoided.

d) Linguistic economy.

   A term should be as concise as possible.

e) Derivability and compoundability.

Productive term formations that allow derivatives and compounds (according to whatever conventions prevail in an individual language) should be favoured.

f) Linguistic correctness.

When new terms are coined, they should conform to the morphological, morphosyntactic, and phonological norms of the language in question.

g) Preference for native language.

1) Even though borrowing from other languages is an accepted form of term formation, native-language expressions should be given preference over borrowed terms from other languages.

2) By applying terminological principles and methods during creation and maintenance of classification systems, some of the challenges encountered when collecting or updating classification system content may be successfully addressed.

h) Managing synonyms.

In the same way that, in terminology standardization, the use of multiple terms to represent the same concept is minimized, the use of multiple names for a class is avoided. However, if domain use dictates that several names are commonly used to represent the class, they can be recorded, but one should be marked as preferred. To decide whether certain names represent the same class, a structured concept system should be used.

EXAMPLE Different words that are similar in meaning usually exist for a reason: “feline” is more formal than “cat”; “long” and “extended” are only synonyms in one usage and not in others. A “long arm” is not the same as an “extended arm”.

i) Detecting duplicate classes.

When the classes of the classification system are mapped to their concepts in a concept system, multiple classes may be found representing the same concept, and one can decide whether they are true duplicates and take appropriate action.

j) Detecting overlapping classes.

A class in a classification system may subsume a set of concepts, and if another class corresponds to one or more concepts in this set of concepts, then this class covers partially the concepts of the first class. This situation can be intended or accidental. By examining the concepts corresponding to the classes, one can correct overlapping classes.

k) Using clear class names and definitions.

Ambiguous class names and poor or incomplete class definitions can lead to misinterpretation and misuse of classes, which can have costly consequences for users. Applying terminological principles, such as definitions that reflect a concept system and class names that are based on a controlled vocabulary, can greatly enhance the usability of the classification system. If certain classes are intended for specific applications, these areas of application should be clearly indicated.

l) Reflecting current practice.

Definitions of concepts referring to classes and properties may still be wrong if they are not in accordance with the current use in business and industry. Therefore, when preparing definitions, it is recommended that domain experts be consulted.

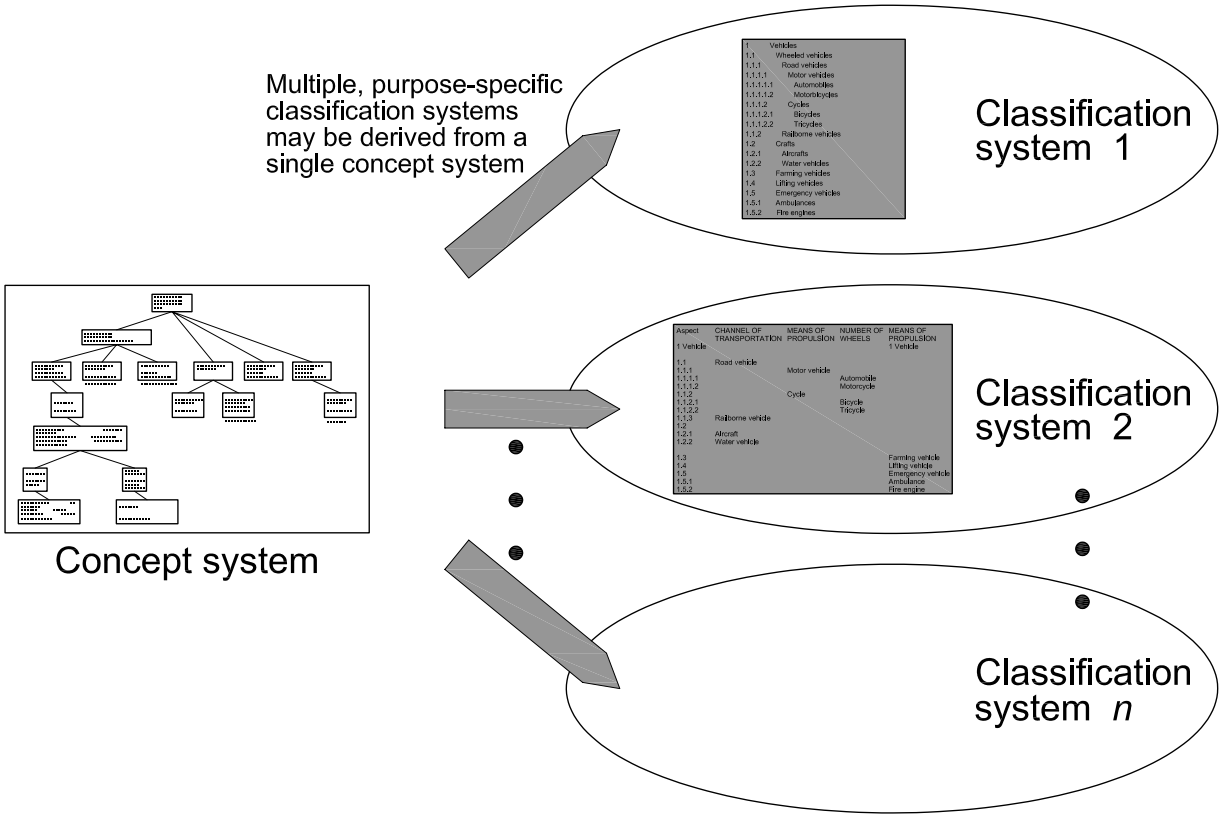
7 Concept systems and classification systems

7.1 Basic principles of concept systems

Concept systems provide the foundation of systematic terminology work. They reflect the knowledge about the concepts within a domain and the relations among them. Concept systems contribute to concept clarification. Thus, they may form a basis for classification systems. They provide a sound basis for developing classification systems in which the area of applicability of each class is clear and precise. Well-defined concepts together with documented relations among them are an important aid to create consistent classification systems. Figure 10 shows a case where multiple, purpose-specific classification systems are derived from a single concept system.

Developing a classification by using a concept system is not a mandatory requirement; however, it is highly recommended.

ISO 704[1] gives an introduction to terminology work, including basic principles of concept systems.



NOTE The presentations of the concept system and the classification systems in this figure are for illustrative purposes only. Thus, the text portions that are part of these illustrations are not important for the interpretation of the figure and can be omitted.

Figure 10 — Classification systems for different purposes, derived from a single concept system

In a concept system, the relations between the concepts are formalized and the characteristics that delimit related concepts are identified (see ISO 704[1]):

— generic relations;

— partitive relations;

— associative relations.

"Generic relations" and "partitive relations" form concept hierarchies, whereas "associative relations" do not. A concept system may comprise all three types of relations. On the basis of these concept relations

and characteristics, it is possible to write consistent and rigorous concept definitions and, in case of synonyms, to choose the preferred term for a concept.

NOTE 1 See Annex B for additional rules for creating hierarchies of concepts and classes.

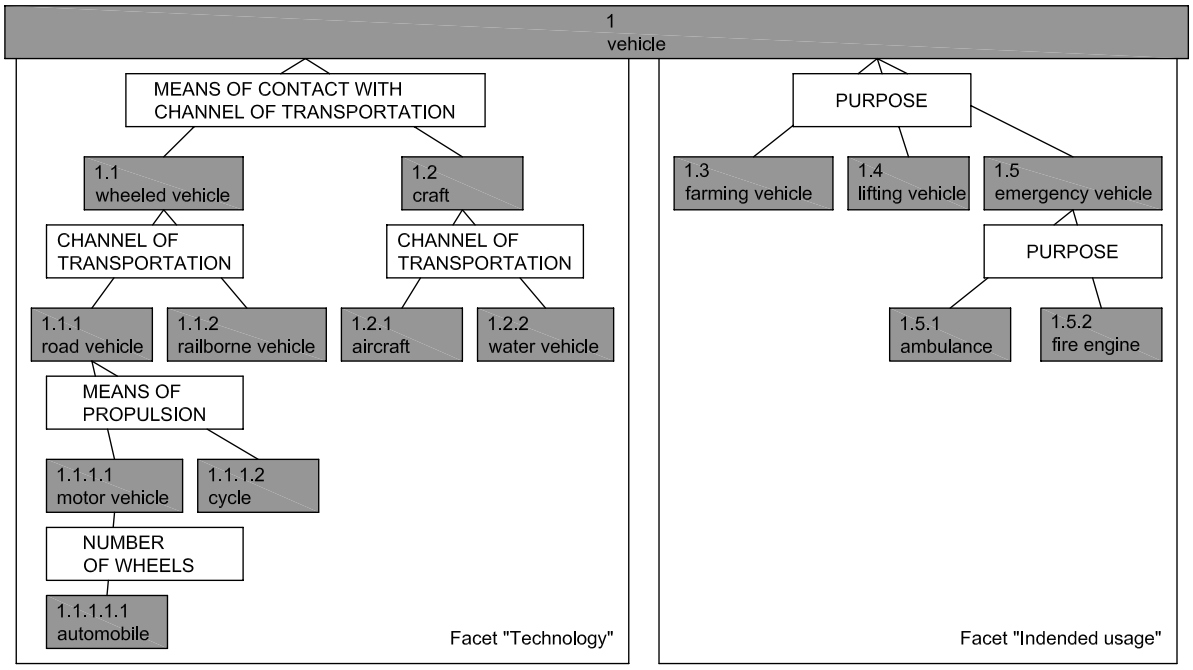
Characteristics that apply to concepts are introduced in the form of features.

EXAMPLE 1 An example of a feature is MEANS OF PROPULSION: *motor*, which characterizes the concept *motor vehicle*, see Figure 11.

NOTE 2 Features can be expressed in a classification system by one or more properties (MEANS OF PROPULSION) related to the respective class(es) and their values (*motor*).

On the basis of features, criteria of subdivision may be introduced, which group concepts and thereby contribute to easily readable structures.

EXAMPLE 2 Figure 11 presents an example of a concept system that focuses on types of vehicles. This concept system is used to explain how to use concept systems. As it is only for illustrative purposes, it does not cover the domain of vehicles to its full extent.



NOTE In this figure, the concept identifier is derived from the identifier of the superordinate concept complemented by an additional number which is unique within its hierarchical level.

Figure 11 — Concept system for types of vehicles

EXAMPLE 3 The concept identifier "1.1.1 road vehicle" comprises: Subordinate concept of "1.1. *wheeled vehicle"* with number "1".

In concept systems, subordinate concepts inherit characteristics from their superordinate concepts. It is possible to introduce polyhierarchy in concept systems, i.e. one concept may be related to two or more superordinate concepts. In this case, the superordinate concepts shall always belong to different criteria of subdivision.

If the superordinate concepts in a polyhierarchy do not belong to different criteria of subdivision, one concept inherits two or more features eventually representing conflicting characteristics. Consequently such concept systems should be corrected. See Figure 12 for an example of illegal polyhierarchy.

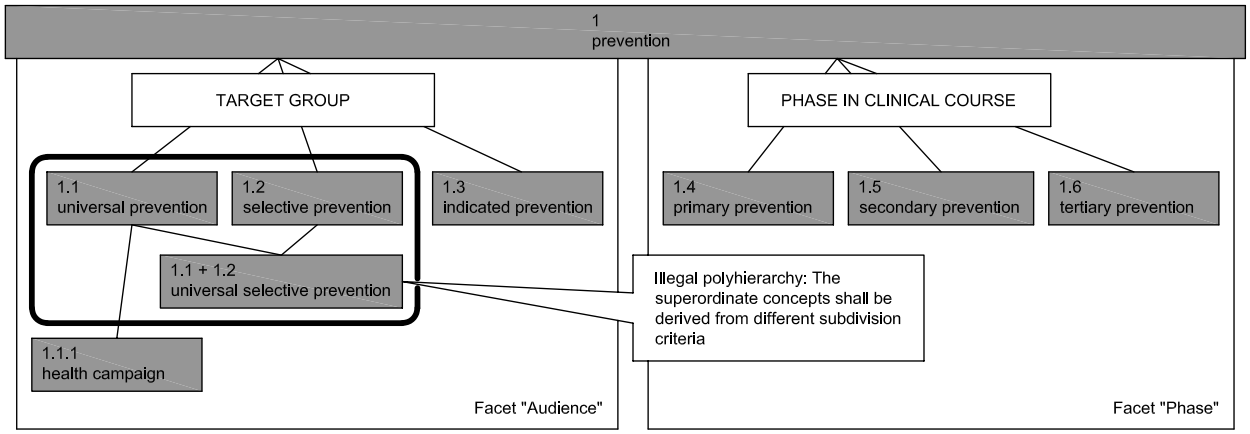


Figure 12 — Example of an illegal polyhierarchy

7.2 Differences between concept systems and classification systems

Concept systems and classification systems primarily differ with respect to purpose. The purpose of a concept system is to provide a simplified representation of knowledge about objects, whereas the purpose of a classification system is to divide objects into classes that form the basis for ordering physical and non-physical things.

The specific purpose of classification systems influences the decision about the arrangement and structuring of its classes. Ideally, the classification system is derived from an underlying concept system that provides the concepts, i.e. the knowledge about the facts that are used to set up the classes of the classification system. This concept system is free from considerations or limitations relating to the area of applicability of the derived classification system. Its role is solely the representation of knowledge about a specific domain.

Depending on purpose, domain-specific rules, desired complexity of the resulting classification system or other considerations, some classes within a classification system may directly relate to specific concepts, while others may cover more than one concept or just a portion of a concept.

The assignment from concept systems to classification systems is free, i.e. there are no strict rules about the mapping of a given concept system element, such as concept or feature. In most cases, concepts are mapped on to one or more classes and feature objects on to one or more property objects. Special cases such as the mapping of a feature on to a set of class objects are also possible. Additionally, cases may occur where certain concept system elements do not have any corresponding element at all in the classification system. The mapping completely depends on the intended area of applicability and the desired level of detail of the classification system. In all cases, the ultimate target is clearly specified semantics for the objects that make up the classification system. If the semantics of some parts of the classification system is unclear, this is an indicator that the mapping from concept system to classification system may need rework. Recommendations for the mapping process are given in 7.4.1.

When relating to a well-defined concept system, the definitions and descriptions within the classification system can be expressed more clearly and concisely. The concept system provides the basis for clear definitions and thus helps prevent overlaps, ambiguities or inconsistencies when specifying the areas of applicability of classes or subdivisions of existing classes into further subclasses.

NOTE 1 More than one classification system can be derived from one concept system to address different user communities who have different requirements for granularity of their classification system (see Figure 10). This is a substantial benefit of using a concept system for modelling a classification system.

NOTE 2 Due to their transparency, concept system-based classification systems can be more easily localized. Having precise information about semantics, characteristics, and area of applicability of the classes is necessary in order to successfully localize a classification system.

However, there are also differences in the structure of concept systems and classification systems. In classification systems the linked elements are referred to as classes. Each class is intended to group a set of like items, separating them from unlike items. In concept systems, one linked element represents one concept.

7.3 Difficulties that may occur in non-concept system-based classification systems

In classification systems, relations between the classes are not specified and the delimiting characteristics of the classes are not always made explicit. This is the case in the extract of the classification system in Figure 13, which was not based on a concept system. The classification had been set up in a kind of "quick and dirty development" not being based on a concept system and thus showing some deficits.

In the example in Figure 13, it is evident that by using principles of concept systems, this system could have been structured in a more logical way, and thus could be intuitively easier to use. The following sections include examples of inappropriate design of the classification system in Figure 13, compared to the design of the concept system in Figure 11.

In Figure 11, the concepts are clearly delimited from each other, which is not the case for the classes in Figure 13. In the concept system the concepts *road vehicle*, *railborne vehicle*, *aircraft* and *water vehicle* are distinguished with respect to CHANNEL OF TRANSPORTATION. Below road vehicle are found the subordinate concepts *motor vehicle* and *cycle* that are delimited with respect to MEANS OF PROPULSION. The concepts *farming vehicle* and *lifting vehicle, emergency vehicle*, and *truck*, are characterized with respect to PURPOSE. The order of the classes in Figure 13 does not make this clear. It is much easier for the users of the classification system to find the relevant class for a product if the classes are presented in a logical order, especially if the classification system comprises many classes and subclasses.

The structure of the classification system in Figure 13 should, therefore, be changed, and it may also be useful to introduce additional criteria of subdivision.

The structure shown in Figure 13 conflicts with the key requirements of consistency and comprehensibility. The consistency requirement is violated because the classes address overlapping aspects of automotive technology. Purpose, channel of transportation, and type of vehicle are mixed and contained as classes on the same hierarchical level.

Because of the varying criteria of subdivision of the classes it is difficult to comprehend the classification. Thus, the second key requirement of comprehensibility is violated. Users may have problems in classifying items correctly using the classification. Conversely, it is very difficult to foresee under which class a given item may be found.

Figure 14 shows the classification system from Figure 13 together with the criteria of subdivision used in Figure 11.

The example in the preceding shows that a classification system which is not based on a concept system may lead to classes that are difficult to understand and thus to eventually erroneous structures. The classification system violates the generic requirements of consistency and comprehensibility (see 5.3). Assignment of properties is also difficult and error-prone as the area of applicability of the classes is unclear.

An approach that avoids some of the above problems can be seen in Figure 15.

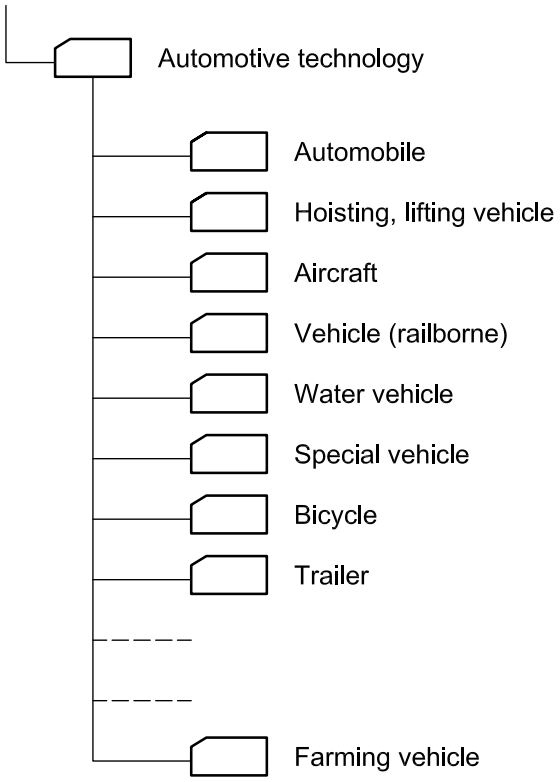


Figure 13 — Section of a defective classification system for types of vehicles

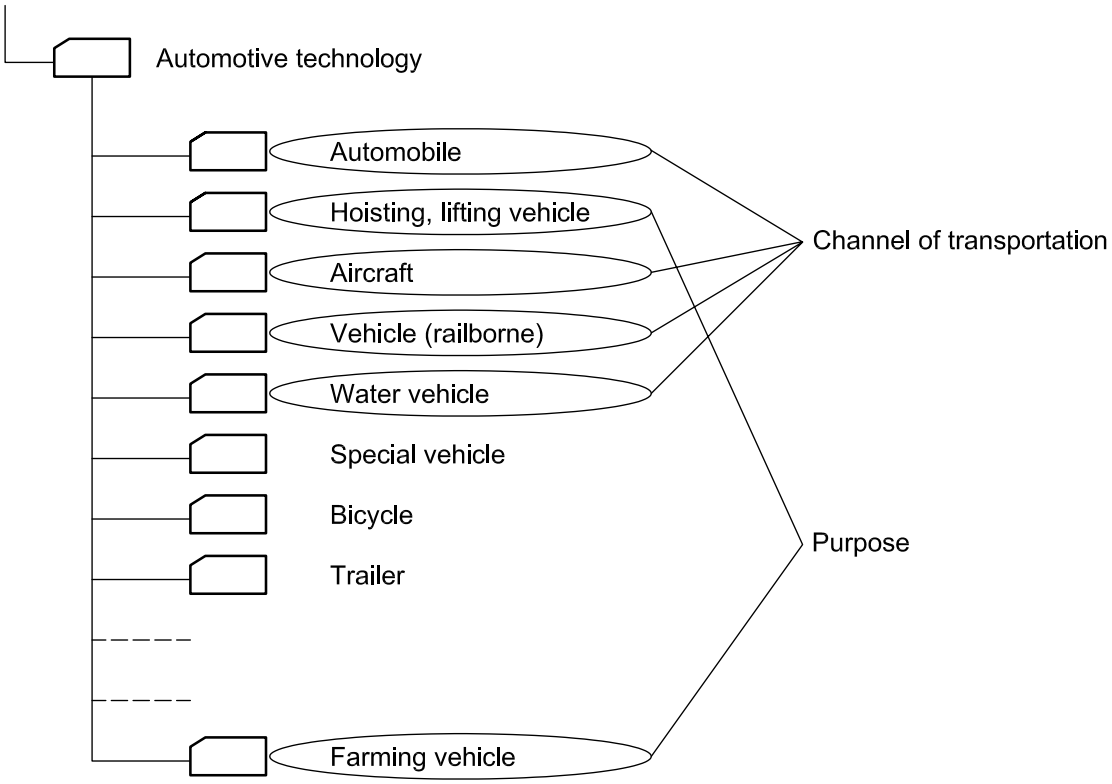


Figure 14 — The classification system of Figure 13 with indication of criteria of subdivision

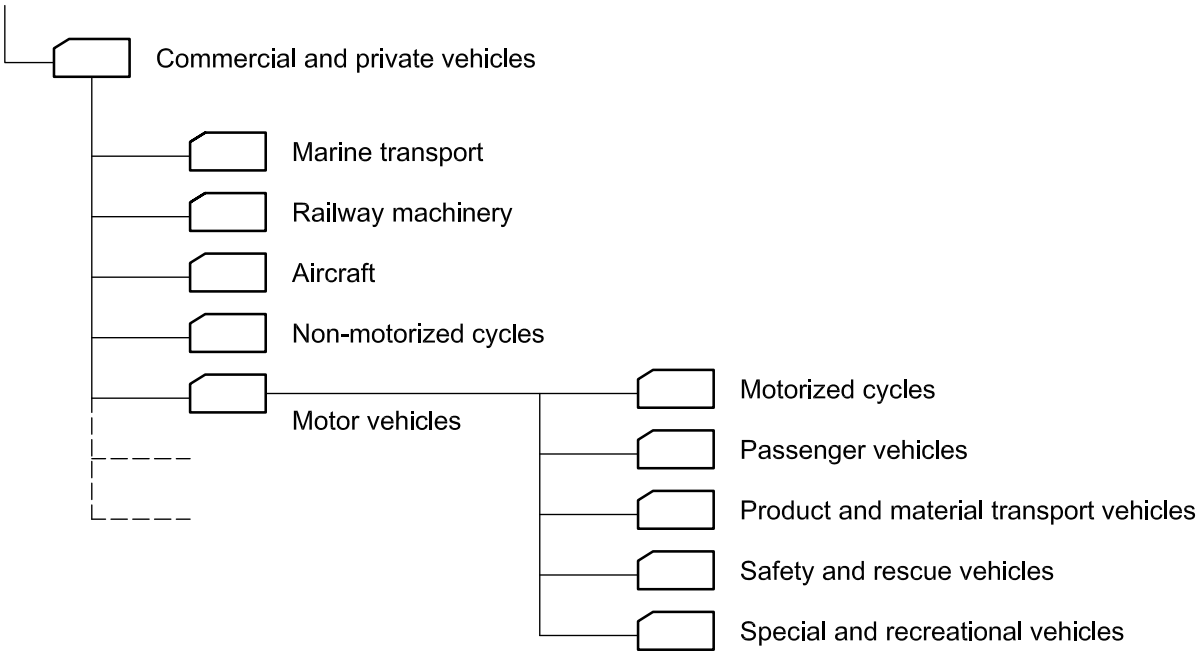


Figure 15 — Classification system with clear structure

7.4 How to use a concept system to build a classification system

7.4.1 Guidelines for creating a classification system on the basis of a concept system

This subclause gives some general recommendations on how to create a classification system on the basis of a concept system. In 7.4.2, the process is described using an example based on the concept system in Figure 11.

In order to create a classification system on the basis of a concept system, steps a) to h) should be followed.

a) Define the area of applicability, purpose, and intended target group of the classification system.

b) Identify relevant concepts within the area of applicability of the classification system.

For the purpose of concept clarification and system consistency, it may be necessary to introduce concepts that do not give rise to classes in the classification system.

NOTE 1 A concept system can comprise concepts that do not map on to classes in the classification system.

c) Analyse the characteristics of the relevant concepts.

d) On the basis of concept characteristics create a concept system, which should be graphically represented by a concept diagram.

e) Generate a systematic list of concepts on the basis of the systematic notations of concepts in the concept diagram.

f) Adjust the systematic list of concepts to meet the needs of the classification system. When making these adjustments, it may be necessary to add or delete concepts in the systematic list of concepts (see Table 4), such as:

1) to introduce additional concepts for concept clarification purposes or for a more detailed presentation of the subject knowledge;

2) to add a concept in several places to avoid structures containing illegal cases of polyhierarchy;

3) to eliminate levels of the concept system that are not wanted because the concepts are too fine grained.

It is recommended that the systematic list of concepts be thoroughly checked for concepts that should not have equivalents in the classification system. These concepts should be deleted from the list.

g) Create a class for each concept and place it in a hierarchical structure that mirrors the structure of the concept system.

h) Assign semantics to the classes by establishing correspondences between the concepts of the systematic list of concepts and the classes of the classification system.

NOTE 2 It can be necessary to modify the outcome of previous steps in the light of the results of later steps in order to receive an optimum result.

A simple example of creating a classification system on the basis of the concept system in Figure 11 is given in 7.4.2. An example of how to create a classification system on the basis of a concept system comprising polyhierarchy is provided in 7.4.3.

7.4.2 Example creating a classification system on the basis of a concept system

The statement specifying the area of applicability shall clearly indicate the coverage of the classification system and, if necessary for clarity, exclusions shall be stated. The intention statement can include information about the purposes and its target groups.

The concept system represented by the concept diagram in Figure 11 has been created on the basis of the characteristics of the concepts [see 7.4.1 step c)].

On the basis of the concept system in Figure 11, it is possible to generate a systematic list of concepts as presented in Table 1 [see 7.4.1 step e)]. This list may serve as a basis for creating the corresponding part of a classification system. From this list, it is possible to derive generic relations by means of the position numbers. For example, “1.1” means that *wheeled vehicle* is a subordinate class of “1 *vehicle*” (generic relation).

During the concept clarification process, it was beneficial to introduce the two concepts *wheeled vehicle* (1.1) and *craft* (1.2), which are not contained in the classification shown in Figure 13.

Table 2 and Table 3 give two different proposals for presenting classes in a classification system on the basis of the systematic list of concepts in Table 1. In both cases, simplifications compared to the systematic list have been made [see 7.4.1 steps e) and f)]:

¾ Table 2 omits the characteristics and simply presents the classification tree resulting from a straightforward mapping of the concepts in Table 1 on to classes;

¾ Table 3 does not contain counterparts to the concepts *wheeled vehicle* and *craft*.

The two concepts *wheeled vehicle* and *craft*, which were found as classes in the original classification in Figure 13, contribute to a clearer overview of the classes in the classification. However, these two classes may not be necessary for the intended use of the classification system, and they may, therefore, be eliminated in order to make the classification system simpler.

Table 1 — Systematic lists of concepts from the concept system in Figure 11

Notation	Concept	Characteristic	Facet
1	Vehicle		
1.1	Wheeled vehicle	MEANS OF CONTACT: wheels	Technology
1.1.1	Road vehicle	CHANNEL OF TRANSPORTATION: road	
1.1.1.1	Motor vehicle	MEANS OF PROPULSION: motor	
1.1.1.1.1	Automobile	NUMBER OF WHEELS: three or four	
1.1.1.2	Cycle	MEANS OF PROPULSION: foot pedals	
1.1.2	Railborne vehicle	CHANNEL OF TRANSPORTATION: rail	
1.2	Craft	MEANS OF CONTACT: body of the vehicle	
1.2.1	Aircraft	CHANNEL OF TRANSPORTATION: air	
1.2.2	Water vehicle	CHANNEL OF TRANSPORTATION: water	
1.3	Farming vehicle	PURPOSE: farming	Intended usage
1.4	Lifting vehicle	PURPOSE: lifting	
1.5	Emergency vehicle	PURPOSE: rescue	
1.5.1	Ambulance	PURPOSE: transport of ill or injured persons	

Table 2 — Classification system without explicit criteria of subdivision

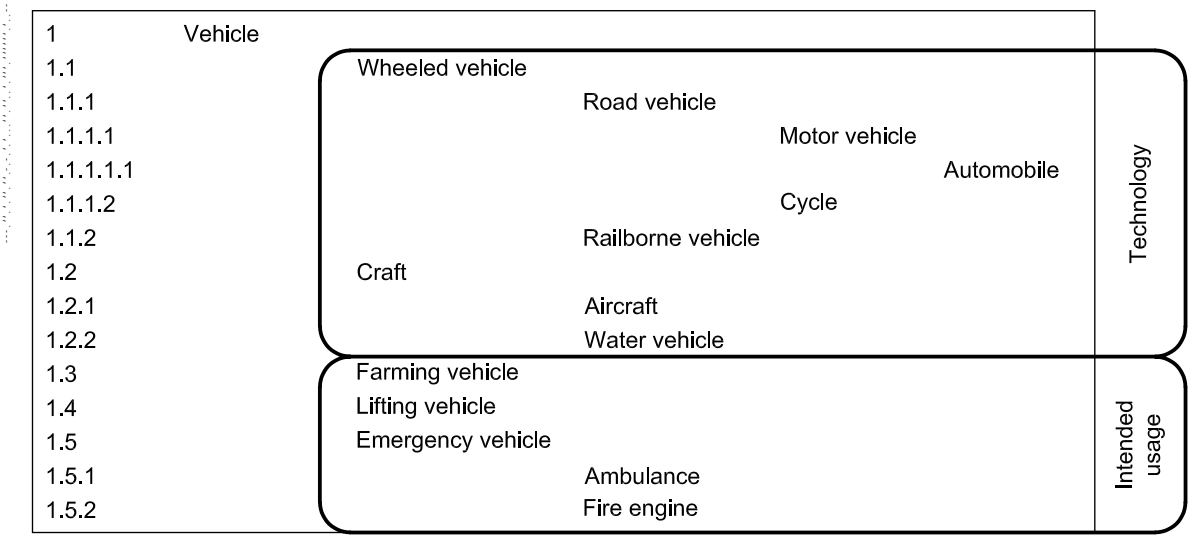


Table 3 — Classification system with explicit criteria of subdivision

			Channel of transportation	Propulsion	Number of wheels	Purpose	
1	Vehicle						
1.1		Wheeled vehicle					
1.1.1			Road vehicle				Technology
1.1.1.1				Motor vehicle			Technology
1.1.1.1.1					Automobile		Technology
1.1.1.2				Cycle			Technology
1.1.2			Railborne vehicle				Technology
1.2.1		Craft	Aircraft				Technology
1.2.2			Water vehicle				Technology
1.3						Farming vehicle	Intended usage
1.4						Lifting vehicle	Intended usage
1.5						Emergency vehicle	Intended usage
1.5.1						Ambulance	Intended usage
1.5.2						Fire engine	Intended usage

7.4.3 Example of a classification system created on the basis of a concept system with polyhierarchy

Figure 16 shows an extract of a draft concept system for various types of wine. This concept system contains several cases of polyhierarchy, i.e. one concept is related to two or more superordinate concepts. The superordinate concepts of a concept in a polyhierarchy shall always belong to different criteria of subdivision. If the superordinate concepts do not belong to different criteria of subdivision, one concept inherits two or more conflicting characteristics.

In Figure 16, it is impossible for one concept to be generically related to both red wine and white wine, i.e. the concept “red white Bordeaux wine” does not exist.

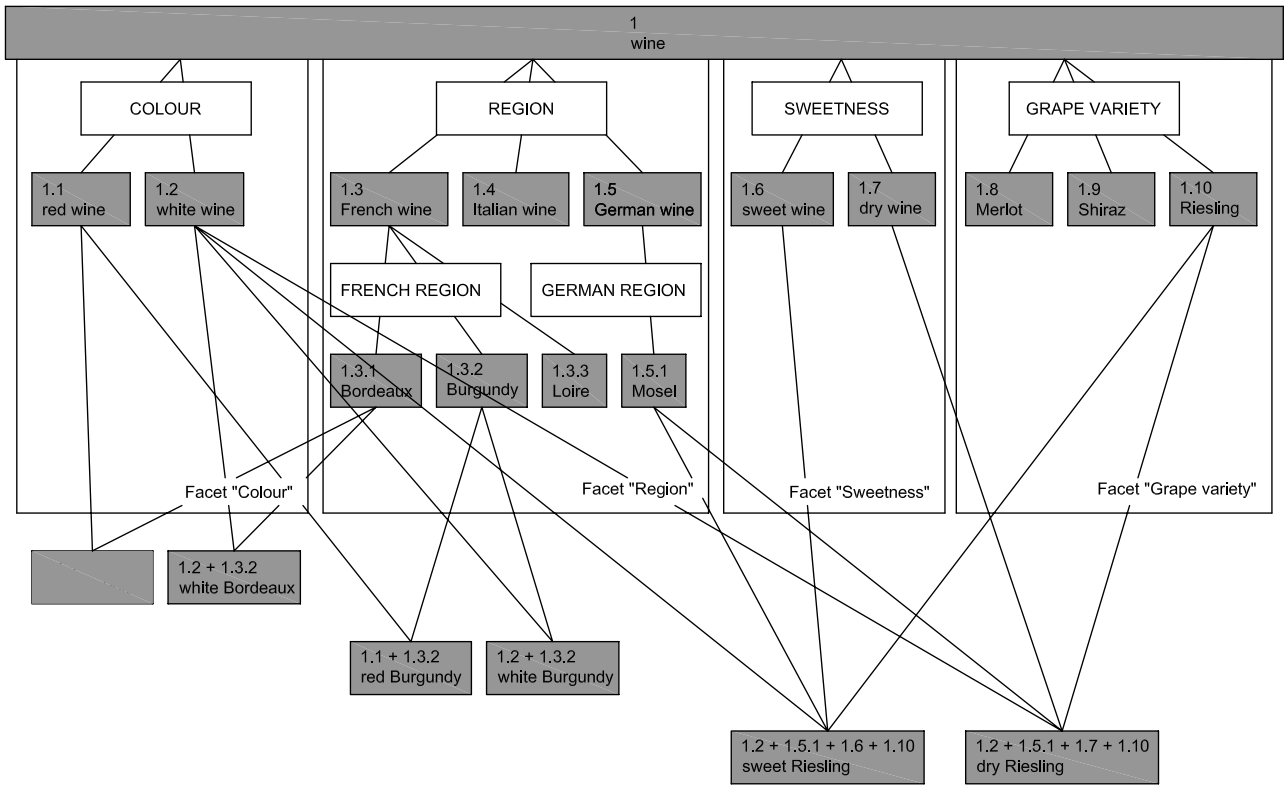


Figure 16 — Extract of a draft concept system for types of wine

Table 4 shows the systematic list corresponding to the concept system in Figure 16. The concepts with double notations, i.e. the concepts that are related to two superordinate concepts, appear in italics.

Table 4 — Systematic list corresponding to the concept system in Figure 16

Notation	Concept	Facet
1	wine	
1.1	red wine	COLOUR
1.2	white wine	
1.3	French wine	REGION
1.3.1	Bordeaux	
1.3.2	Burgundy	
1.3.3	Loire	
1.4	Italian wine	
1.5	German wine	
1.5.1	Mosel	
1.6	sweet wine	SWEETNESS
1.7	dry wine	
1.8	Merlot	GRAPE VARIETY
1.9	Shiraz	
1.10	Riesling	
1.1 + 1.3.1	*red Bordeaux*	
1.2 + 1.3.1	*white Bordeaux*	
1.1 + 1.3.2	*red Burgundy*	
1.2 + 1.3.2	*white Burgundy*	
1.2 + 1.5.1 + 1.6 + 1.10	*sweet Riesling*	
1.2 + 1.5.1 + 1.7 + 1.10	*dry Riesling*	

In Table 5, the criterion of subdivision SWEETNESS and the subordinate concepts under this criterion are marked for deletion by conversion to italics. This means that the classification system will not distinguish the characteristic SWEETNESS.

Table 5 shows the final version of this extract of a classification system. This system may be used both for physically organizing a wine inventory or for presenting products on the web.

A criterion of subdivision should be eliminated if it is not needed by the area of applicability and target group of the classification system. In this case, the developer of the system needs to determine if SWEETNESS is mandatory or not.

When the concept system is further developed with respect to other criteria of subdivision, such as GRAPE VARIETY, it may be necessary to reorganize the classification system accordingly.

The systematic notations may be changed into simplified identification numbers.

Table 5 — Concepts marked for deletion (cf. Table 4)

Notation	Concept	Facet
1	wine	
1.1	red wine	COLOUR
1.2	white wine	
1.3	French wine	REGION
1.3.1	Bordeaux	
1.3.2	Burgundy	
1.3.3	Loire	
1.4	Italian wine	
1.5	German wine	
1.5.1	Mosel	
1.6	*sweet wine*	*SWEETNESS*
1.7	*dry wine*	
1.8	Merlot	GRAPE VARIETY
1.9	Shiraz	
1.10	Riesling	
1.1 + 1.3.1	red Bordeaux	
1.2 + 1.3.1	white Bordeaux	
1.1 + 1.3.2	red Burgundy	
1.2 + 1.3.2	white Burgundy	
1.2 + 1.5.1 + 1.10	Riesling wine	
1.2 + 1.5.1 + 1.6 + 1.10	*sweet Riesling*	
1.2 + 1.5.1 + 1.7 + 1.10	*dry Riesling*	

The final classification system (Table 6) offers three classification trees in accordance with the facets COLOUR, REGION, and GRAPE VARIETY. The classes belonging to the facet trees may be freely combined to characterize types of wines that are in the area of applicability of the classification system. Additionally, frequently used cases such as 'Red Burgundy' or 'Riesling wine' are included as predefined categories.

Table 6 — Final classification system

Notation	Facet	Class	Class	Class
1		wine		
1.1	COLOUR	red wine		
1.2		white wine		
1.3	REGION	French wine		
1.3.1			Bordeaux	
1.1 + 1.3.1				red Bordeaux
1.2 + 1.3.1				white Bordeaux
1.3.2			Burgundy	
1.1 + 1.3.2				red Burgundy
1.2 + 1.3.2				white Burgundy
1.3.3			Loire	
1.4		Italian wine		
1.5		German wine		
1.5.1			Mosel	
1.8	GRAPE VARIETY	Merlot		
1.9		Shiraz		
1.10		Riesling		
1.2 + 1.5.1 + 1.10				Riesling wine

8 Requirements for an internationalized classification

8.1 Motivation

Despite the use of the English language as lingua franca in international trade, many people throughout the world have limited command of that language. Even in countries such as the USA, localization to languages other than English may be desirable due to the fact that large segments of the population are not anglophones.

Additionally, many customers feel more comfortable if they can have details on products or services in their own language and thus localization can make a product more competitive. Examples 1 and 2 show cases where localization efforts are beneficial.

Situations where localized content should be available include:

— information exchange with local authorities;

— operation of equipment by local operators;

— post-sales support to local staff;

— regulatory requirements;

— required local content as part of industry projects.

EXAMPLE 1 A rig for the oil industry in Brazil has an inventory of nearly 45,000 different items, from toilets to high technology equipment. These rigs constantly undergo maintenance, which requires sophisticated management of parts information. Large volumes of parts are regularly imported into the country. Each shipment is accompanied by an invoice and packing list describing the shipped items. Brazilian customs regulations for the oil and gas industry require detailed specifications of each part in Portuguese.

EXAMPLE 2 When a “nylok shoulder for v-shear ram block screw” is imported by a company located in Brazil, the item is described on the invoice simply as a “screw”. In order for the part to comply with the strict criteria of the customs examination, the invoice must specify more precisely that it is part of a blowout preventer, a piece of oilfield exploration equipment. Therefore, if the item is translated into Portuguese and classified as “parafuso de nylok de ressalto para bloco de gaveta de corte”, the customer is eligible for the associated tax exemption.

8.2 Enabling multilingual environments

8.2.1 General

The task of enabling a classification system for a multilingual environment is carried out using two different methods: internationalization and localization.

8.2.2 Internationalization

The process of internationalizing a classification system covers design and development of a classification system consisting of two or more parallel versions that vary in culture, region or language.

EXAMPLE A company in Germany has affiliates in a number of other countries, and it wants to create a classification system that exists in parallel in the languages of these countries, i.e. the company wants from the beginning to develop the system in parallel in all relevant languages.

For classification systems, there are two types of internationalization:

— internationalization of content;

— internationalization of data model, metadata, and system interface.

This International Standard only covers the internationalization of content.

8.2.3 Localization

The process of localization of a classification system covers the adaptation of a classification system to meet the requirements of a target locale, i.e. the language, cultural and other requirements of a specific target market.

EXAMPLE A company in Germany has developed a classification system in German, and later on they want to cooperate with other companies in English, i.e. the classification system is originally created in German, and later on an English version is needed.

For classification systems, there are two types of localization:

— localization of content;

— localization of data model, metadata, and system interface.

This International Standard only covers the localization of content.

8.3 Class identifiers

Classification systems play an indispensable role as communication aids for automated information exchange within business processes. Therefore, class identifiers shall establish the identity of each class unambiguously. For that purpose, globally unique identifiers shall be used, in accordance with International Standards.

NOTE There exist various well-acknowledged methods to create and assign identifiers to classes or concepts. However, such methods are outside of the scope of this International Standard and are not further explained.

The following standards specify structure and content of identifiers:

— ISO/IEC 6523;

— ISO/IEC 15418;

— ISO/IEC 15459-6;

— ISO/TS 29002-5.

9 Internationalization aspects

9.1 General

Instructions on how to create a classification system on the basis of a concept system are given in 7.4.1. This clause provides guidelines for creating parallel versions of a classification system in two or more languages. Such parallel versions of a classification system may be based on parallel concept systems.

Internationalization is a complex process that ideally should be done once. It is beneficial for the work if the requirements of the intended target locales are known.

9.2 Maintaining parallel concept systems

When internationalizing concept systems, be prepared for the possibility that the subsequent steps of localization may call for concepts that are not fully equivalent in the envisaged languages, but overlap only to a certain degree. Therefore, internationalization should include provisions to maintain multiple concept systems in parallel that may correspond to each other partly or completely.

If all concepts in two or more languages are equivalent, i.e. the characteristics of the concepts in the languages are equivalent, the concept systems of the languages correspond to each other. The concept systems may be merged, and the equivalent concepts are located at the same position in a multilingual concept system.

However, very often concepts and concept systems in different languages vary. Concepts may only exist in one language community or concepts may slightly differ between language communities. In the first case, it is necessary to introduce a new concept in the concept system and propose a suitable designation for the language in question. In the second case, the degree of equivalence should be described in detail, and it should be determined if the terms chosen to represent those concepts can be used as equivalents of each other.

EXAMPLE See Table 7 for the different interpretations of tree, wood, woods and forest in various European languages.

9.3 Guidelines for the creation of internationalized classification systems

In order to create multilingual classification systems on the basis of concept systems, steps a) to f) may be followed.

a) Define the area of applicability, purpose, and intended target group of the classification system.

b) Identify relevant concepts in both languages within the area of applicability of the classification system.

NOTE 1 For the purpose of concept clarification and system consistency, concepts can be introduced that do not give rise to classes in the classification system.

c) Create a concept system for each language, based on the characteristics of the concepts, which may be graphically represented by a concept diagram.

d) Compare the language-specific concept systems in order to identify missing or mismatching concepts.

1) If all concepts in the desired languages are equivalent and the concept systems have the same structure, then it is possible to create parallel localized versions of the classification system.

2) If concepts and concept systems differ, approaches i) and ii) for creating parallel versions of the classification system may be considered.

   i) If a concept exists in one language only, call it language A, it may be decided to introduce a placeholder for this concept in the other language together with a note expressing the fact that this concept was introduced because there was no direct counterpart in language B. Additionally, a note should be given to classes derived from such placeholders, informing the user that the concepts behind the classes in question only exist in language A.

   ii) If the concepts in the desired languages are not fully equivalent, the differences between the concepts should be described in detail, and one of solutions I) or II) may be chosen.

      I) If the terms designating the two concepts may be used as equivalents of each other, classes can be created in both languages on the basis of the proposed translations. A note should be provided, informing the user that the underlying concepts are not fully equivalent.

      II) If the characteristics of a concept used in the desired language B, differ to such a degree from the related concept used in language A that the terms designating this concept cannot be used as equivalent, a backward translation of language B terms back to language A may be proposed. Based on the results of the backward translation process, additional concepts may be identified that need to be introduced to the concept system related to language A. A note should be given to classes derived from such concepts to inform the user that the concepts behind the classes in question only exist in language B.

e) Create systematic lists of concepts on the basis of the two concept diagrams in the two languages.

   NOTE 2 These systematic lists can be based on the systematic notations of the concepts in the concept diagrams.

f) Align the systematic list of concepts to the needs of the classification system.

   1) Remove concepts that are too specific for the intended classification system.

   2) It may be necessary to delete concepts that have been temporarily introduced into the concept list for clarification purposes or to adhere to formal rules. For example, in terminology theory, a concept is delimited from a coordinate concept by at least one delimiting characteristic. If a placeholder was put into the concept system to account for this rule, but there are still no objects within the classification system that reflect this one delimiting characteristic, then such a concept need not have a corresponding class in the classification system.

   3) Remove duplicate concepts that are contained in the systematic list. Such duplicates may occur in the case of polyhierarchy because a concept may be the subordinate concept to more than one superordinate concept.

   4) Map the concepts contained in the systematic list of concepts into classes for the classification system.

10 Localization aspects

10.1 General

Classification systems are often developed within one locale taking into consideration the local technical, social, scientific or cultural specialities and peculiarities of that region. Such locale-specific classification systems are often difficult to apply and use outside of that locale. Due to cultural and linguistic differences, the meaning of the classes developed in one locale can be misinterpreted in other locales. It may be necessary to redesign parts of locale-specific classification systems when localizing them for other locales.

10.2 Leading locale

Most activities and projects occur against a social and cultural background. This background largely influences the way that concepts are perceived and knowledge is structured. To interpret definitions and explanations, it is always necessary to take into account the cultural background against which concepts or classes are specified.

The leading locale is the geographical and cultural environment in which a concept is conceived and perceived. For interpretation problems, the leading locale shall serve as reference environment.

When multilingual classification systems are localized to additional locales, it is important to know which language version should serve as reference for the translation process, i.e. which language is the original source language from which the multilingual system was derived. This is necessary to ensure that a target language (language B) is not used as the source language for further translation, a practice which can sometimes lead to poor translation results.

10.3 Names for classes, properties or values in different locales

If concepts behind a classification system are equivalent in the different locales, class names, property names, and value names can be denoted by equivalent names in the language of each locale.

EXAMPLE Definition in multiple languages

English 10000276 Wine — Still "Includes any products that can be described/observed as an alcoholic beverage made by the fermentation of the juice of the grapes, usually having an alcoholic content by volume of 14 % or less."

French 10000276 Vin — Tranquille « Comprend tous les produits qui peuvent être décrits/observés comme étant des boissons alcoolisées élaborées à partir de la fermentation de jus de raisin, ayant généralement une teneur en alcool maximale de 14 %. »

Russian 10000276 Вино — Без газа « Включает в себя все продукты, которые могут описываться/рассматриваться как алкогольный напиток, изготовленный путем ферментации сока винограда, обычно с содержанием алкоголя 14 процентов или менее. »

10.4 Locale-specific objects, classes, properties and value domains

In certain locales, objects may exist that were not considered when building the classification system for the leading locale. In many cases, the definitions of the classes in question have to be extended by additional notes to make clear that those objects are included. If this strategy is not feasible, new classes have to be introduced.

EXAMPLE 1 It is possible that a North American classification system for automobiles does not include a class for micro cars, such as the "Smart"[2)] automobile. When localizing this system for use in Europe, it can be necessary to add new classes or to extend existing ones.

The classification system shall allow for new classes to be added without changing the existing classes or the class hierarchies.

Even if classes needed for certain target locales already exist in the classification system, different or additional properties may be required to describe them in a way that is meaningful for those locales.

The classification system shall allow for new properties to be added to characterize new classes or extend existing ones. A classification system developed for a specific locale may not need all the properties defined for the leading locale or for other locales. Thus, a classification system may use a subset of the properties that are used by other corresponding classification systems.

2) Product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

Systematic class or property designations shall be designed in a way that there is enough room for new classes or properties to be added without violating the rules and principles for composing them.

Even if existing classes and their properties are applicable in a local context, different value ranges, measurement units or other scales may be required.

The different values required for properties of classes in the different localized versions of a classification system should be available in the classification system of the leading locale or some other centralized repository. This is to prevent inconsistencies such as the creation of different value names for the same value concept.

EXAMPLE 2 Temperature in degrees Celsius or degrees Fahrenheit, size in metres or feet, different scales for steel products, different standards.

10.5 Different classification criteria

In addition to new classes, new properties, and new value domains, localizing a classification system may also lead to new and different criteria for creating classes. Although the objects that have to be classified may be totally identical, a different tradition of grouping them into classes may be specific to a locale.

EXAMPLE 1 In English, the term "screw" refers to externally threaded fasteners capable of being inserted into holes in assembled parts, of mating with a preformed internal thread or forming its own thread, and of being tightened or released by torqueing their head. The term "bolt" refers to externally threaded fasteners designed for insertion through holes in assembled parts that are normally intended to be tightened or released by torqueing a nut. The German term "Schraube" refers to all kinds of threaded fasteners and comprises both screws and bolts.

EXAMPLE 2 Passenger cars are classified differently in many countries although the cars may be exactly the same. Cars may be classified by size, by price or by some other criterion. The classification according to the size may depend on the typical sizes of cars in a country. *Mid-size cars* in the US may be well over 4,80 m and in Europe they are normally less than 4,70 m.

In cases where concepts used stem from several sources, alternate concept identifiers may be useful to indicate the multiple origins of the concept.

EXAMPLE 3 Collections of units are maintained by many standardization bodies, e.g. ANSI, IEC, ISO, UNSPSC.

10.6 Different intensions of concepts

Depending on the language and cultural conventions, the areas of applicability of concepts may differ. Such differences may affect clarity or correctness of textual parts of the classification system, such as definitions, when applied to different locales. As a consequence, such parts may need reworking. It may also be necessary to rework parts of the classification system to reflect the areas of applicability of the concepts within the different locales.

EXAMPLE See Table 7.

Table 7 — Cultural relativity in word meanings

<table>
<tr><th>English</th><th>German</th><th>Danish</th><th>French</th><th>Italian</th><th>Spanish</th></tr>
<tr><td>Tree</td><td>Baum</td><td rowspan="2">Træ</td><td>Arbre</td><td>Albero</td><td>Árbol</td></tr>
<tr><td rowspan="2">Wood</td><td rowspan="2">Holz</td><td rowspan="3">Bois</td><td rowspan="2">Legno</td><td>Leña</td></tr>
<tr><td rowspan="2">Skov</td><td>Madera</td></tr>
<tr><td>Woods</td><td rowspan="2">Wald</td><td rowspan="2">Bosco</td><td rowspan="2">Bosque</td></tr>
<tr><td>Forest</td><td>Forêt</td><td>Foresta</td><td>Selva</td></tr>
</table>

10.7 Brand names

Appellations of companies or of brands may occur in textual parts of a classification system. Depending on the locale such appellations may differ and thus may be subject to localization.

Use of appellations of companies or of brands as class names or in definitions should be avoided. When using such appellations in examples, be aware that the associations accompanying the name are often limited to a specific region.

10.8 Further cultural aspects

10.8.1 General

Localization is more than finding the equivalent terms in language B (the target language) for textual content. Localization may require far-reaching changes of the textual and graphical content of the classification system. Therefore, special attention should be paid to areas such as:

a) pictures and figures;

b) formulae;

c) currencies;

d) dates and calendars;

e) numerals;

f) units of measure.

For software applications, the following features are frequently embedded in the operating system and do not require extra work on the developer's side. Nevertheless such differences may largely affect representation and interpretation of content and, therefore, should be taken into consideration:

— formatting and displaying data;

— fonts;

— typography;

— text expansion.

10.8.2 Visual elements

Visual elements such as pictures or technical line drawings can be very effective at illustrating a concept. However, to facilitate internationalization and localization, the content requires careful selection to avoid misinterpretation. Cultural differences challenge the design and implementation of icons and symbols for international use. What is meaningful and natural for one group may be ambiguous, unintelligible or arbitrary for another.

People interpret visual elements subjectively, based on their personal and cultural background. How people acquire, organize, and utilize information is related to how they have learned to process information.

When developing visual elements for use in a global context the following types of content should be used with great care or avoided:

— letter figures;

— human body elements and body language;

— humour, puns, and slang;

— ethnic, racial, political, and religious content;

— gender-specific elements;

— animals;

— sexual and violent elements;

— regional conventions, such as reading direction, date or time, and currencies;

— metaphors, mythology and folklore;

— sports-related activities or environments;

— elements or characters from literature, film or television.

Including text in visual elements should be avoided, since the text would have to be translated for each target locale.

NOTE 1 Within ISO and IEC, sets of icons and symbols are globally standardized, such as IEC 60417-DB,[17] ISO 7000[3] or ISO/IEC 11581.[8] These standards help to express content in an internationally accepted way.

NOTE 2 Charts that depict curved shapes or trends relying on a left to right reading, such as bar charts, can be misinterpreted in communities that read from right to left. Provide a direction-neutral representation or a separate chart for each reading direction.

EXAMPLE Visual elements such as curves or bar charts depicting trends or mathematical functions possess almost always a reading order, whereas diagrams showing charts such as pie charts or data models may be direction-neutral. Any characters or numerals presenting text or numbers always have a reading direction.

10.8.3 Formulae

Mathematical formulae are a very precise representation of mathematical concepts. They are often used to precisely define the semantics of classes or characteristics. Nevertheless, mathematical notation is also subject to cultural diversities, requiring different fonts, symbols, writing directions or other adaptations.

EXAMPLE 1 English formula:

$$f(x)=\begin{cases}\sum_{i=1}^{s} x^{i} & \text{if } x<0\\ \int_{1}^{s} x^{i}.\mathrm{d}x & \text{if } x\in S\\ \tan\pi \text{ otherwise (with } \pi\approx 3{,}142\text{)} & \end{cases}$$

EXAMPLE 2 French formula:

$$f(x)=\begin{cases}\sum_{i=1}^{s} x^{i} & \text{si } x<0\\ \int_{1}^{s} x^{i}.\mathrm{d}x & \text{si } x\in S\\ \tan\pi \quad \text{sinon (avec } \pi\approx 3{,}142\text{)} & \end{cases}$$

EXAMPLE 3 Machrek (Arabic) formula:

$$ت(س) = \begin{cases} \text{مجـ}_{ب=1}^{ص} \; س_{ب} & \text{إذا كان } س > 0 \\ أ_{ب} \; س^{ب} ، \; س & \text{إذا كان } س \ni م \\ \pi \; \text{ظا} & \text{غير ذلك (مع } \pi \simeq 3{,}1416) \end{cases}$$

10.8.4 Currencies

Although there is an International Standard for currency codes (ISO 4217[2]), currency formatting still has regional diversities. Thus, currency formatting shall take into consideration the following elements:

— currency symbol;

— currency symbol placement;

— negative-amount display;

— separator characters.

EXAMPLE Examples of different ways for noting currencies include:

a) the currency is represented by a pre-defined symbol like the European Euro "€" or by a combination of letters like "CHF" for the Swiss franc;

b) the currency symbol can be placed either before or after the digits;

c) there are various methods to display negative amounts, e.g.:

   1) in the UK, the negative sign is before both the currency symbol and the number,

   2) in Denmark, the negative sign is between the currency symbol and the number,

   3) in the Netherlands, the negative sign is after the number.

10.8.5 Dates and calendars

Although there is an International Standard for date formats (ISO 8601[4]), date formatting still is not uniform throughout the world. Although each date displays the day, month, and year, their presentation order and separators can differ. There can even be differences between regions within the same country.

In addition to date formatting, one may need to adapt to a variety of calendars. Although the Gregorian (Western) calendar is in widespread use, some cultures use other calendars, such as the Hijri (Islamic) calendar.

EXAMPLE Comparison of the long date format of Wednesday, March 07, 2001, between English (US), Spanish (Spain), and Japanese:

Table 8 — Regional differences in date formats

Region	Long date format
English (US)	Wednesday, March 07, 2001
Spanish (Spain)	miércoles, 07 de marzo de 2001
Japanese	2001年3月7日

10.8.6 Numerals

Numeric values are structured in a culture-specific way. During localization the local conventions for structuring numeric values have to be taken into consideration.

EXAMPLE 1 Thousands separator. In the USA, the character is a comma ",". In Germany, depending on the length of the numerical value, there is no thousands separator or the character used is either a full stop "." or a space character. Thus, one thousand and twenty-five may be displayed as "1,025" in the USA and "1.025" in Germany.

EXAMPLE 2 Decimal separator. In the USA, the character is a full stop ".". In Germany, the character is a comma ",". Thus, one thousand and twenty-five and seven-tenths is displayed as "1,025.7" in the USA and "1.025,7" in Germany.

EXAMPLE 3 Negative numbers. Instead of the minus sign "–" appearing at the beginning of the number, the minus sign "–" may appear at the end of the number. Other conventions include dashes, parentheses or even a colour such as red. Thus, a negative three hundred fifty-six could be displayed as:

— –356

— 356–

— (356)

EXAMPLE 4 Shape or correspondence. The numbers may be shaped differently or not have a one-to-one correspondence. For example, Japanese has more characters (representing non-zero numbers ending in "0") than Arabic numerals; the last character shown here represents the number 10:

0	1	2	3	4	5	6	7	8	9	
0	一	二	三	四	五	六	七	八	九	十

EXAMPLE 5 Digit grouping: The sizes for each comma-delimited group of digits to the left of the decimal can also vary:

— USA: 123,456,789

— Hindi: 12,34,56,789

10.8.7 Units of measure

Throughout the world, things are measured using different units and scales. Local conventions or legal requirements may necessitate the use of units that differ from those used in the leading locale.

EXAMPLE Use of different unit systems:

— International System of Units (e.g. metres, litres, grams);

— Imperial System (e.g. feet, inches, pounds).

11 Workflow and administration issues

The content of any classification system reflects the state of knowledge or technology that was valid at the time of its creation. As knowledge and technology are constantly evolving, the content of classification systems should be maintained continuously to avoid gaps and outdated concepts. Ongoing changes may need to be made to ensure that a classification system continues to address the needs of users worldwide.

Therefore, the responsibility for managing a classification system shall be assigned to an organization that is dedicated to this task. This organization shall oversee the addition and removal of concepts and classes, and approve the terminology used for names and descriptions.

When terminology and concepts from classification systems are used in business processes they often play a strategic role. Therefore, a classification system should always completely cover its domain while remaining stable, i.e. being free from unexpected changes.

When changes are implemented, they shall be clearly documented with complete historical and administrative information indicating the nature of the change, who made it, and when.

Additionally, all classification system content shall, once released for public use, never be deleted to allow users to refer also to content which was issued in earlier versions. Content that is no longer valid shall be marked as obsolete.

Therefore, the following requirements shall apply.

— Each classification system shall have an address where users can access the latest version of the classification system and its contents.

NOTE 1 In many cases this is a web page link from which users can download the desired information.

— The classification system shall record change management information whereby any user can unambiguously determine the version and revision history, as well as processing status of any data entered in the system.

— No hidden changes shall occur. All modifications to data shall be recorded. The process for requesting changes and resolving problems shall be documented.

NOTE 2 Changes to one class can affect other related classes. The policy of how such changes affect other classes is subject to rules set by the maintaining organization.

— Records in localized versions of a classification system shall carry their own change management information which shall be independently maintained from the change management information assigned to the records in the environment of the leading locale. Localized instances of data shall contain a reference to the corresponding instance of data from the leading locale, for comparison and verification purposes.

— To avoid inconsistencies between the original version of a classification system and its localized variants, the localized version of any content shall be updated when the corresponding content in the original version changes. However, due to the time it takes to make such updates, there may be short periods when the localized version and the original version of a classification system are not completely synchronized. These periods shall be kept to a minimum.

— An archive shall be maintained where users may access superseded versions of the classification system and its content for reference purposes.

NOTE 3 ISO/IEC Directives, Part 1:2012,[20] Annex H; ISO 10007;[5] and ISO 11179-6[7] provide guidelines on setting up registration authorities and processes to create and maintain electronic repositories, such as classification systems and dictionaries.

Annex A
(informative)

Descriptive information of existing classification systems

A.1 General

This annex provides examples for the descriptive information (see 5.5) of classification systems.[3)]

A.2 eCl@ss®

A.2.1 General

eCl@ss® is a hierarchical system for grouping materials, products and services according to a logical structure with a level of detail that corresponds to the product-specific properties that can be described using properties conforming to standards.

Products and services can be assigned to the four-stage, numeric eCl@ss class structure. Search terms and synonyms permit comfortable searching of products and services within the classification.

In Release 6.2, eCl@ss® comprises a total of 32 832 classes. These classes are divided as follows:

Level 1: 26 Segments

Level 2: 564 Main groups

Level 3: 4 982 Groups

Level 4: 27 952 Subgroups

A.2.2 Area of applicability and purpose

eCl@ss® focuses on efficient support for all business processes throughout the entire product lifecycle. It provides a complete product description and classification system, including a class hierarchy for categorizing products and clear multilingual textual definitions for the classes. Standard sets of properties allow a detailed description of the categorized products and services.

A.2.3 Leading locale

Change requests are required to be submitted in English (US) and the respective local language variant, preferably in German.

For German change requests, the new German orthography rules are recommended.

A.2.4 Definition and intentions of levels

The class structure represents procurement markets as well as products and services. It is made up of a hierarchy of four levels, which are indicated by eight digits (two for each level, e.g. 21-01-02-03). The first three levels — segments, main groups and groups — represent procurement markets. See Figure A.1.

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3) eCl@ss® and GS1® are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

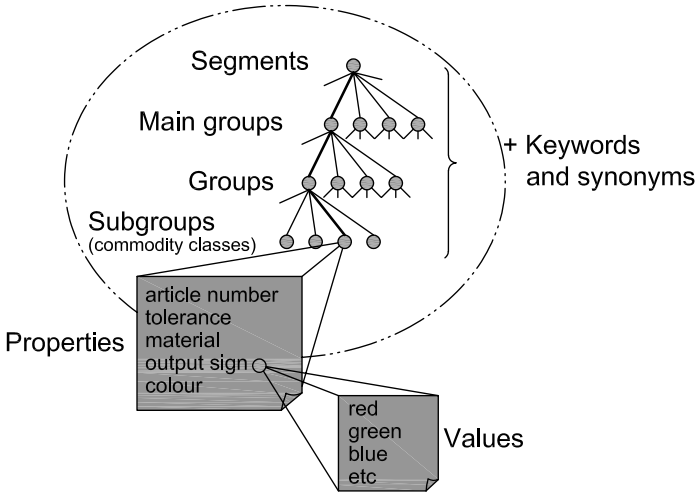

Figure A.1 — eCl@ss structure

The fourth level — subgroups — represents products and services.

Keywords and synonyms serve as a quick, efficient means for locating product classes.

On the fourth level, products and services can be unambiguously described by properties (e.g. material, colour, article number). The sum of all properties of a subgroup is called a set of properties.

A property can have values which make up the property (e.g. property: colour, value: red). The sum of all values of a property is called a set of values. A set of values is open, which means it does not have to be complete.

The structure elements of eCl@ss are classes, keywords, synonyms, sets of properties, properties, sets of values and values.

All structure elements have specific attributes, e.g. preferred name, short name, definition.

A.2.5 Other descriptive requirements

Licensing and copyright

General Conditions of Use, Version 2.0, Status June, 7, 2007 at
http://www.eclassdownload.com/catalog/conditions.php

Identification of classification system owner

eCl@ss e.V.
Postfach 10 19 42
50459 KÖLN

Konrad-Adenauer-Ufer 21
50668 KÖLN
Germany
eMail: info@eclass.de
Web: http://www.eclass.eu

— Contact details of classification system owner

Monika Benke
eCl@ss e.V.
Postfach 10 19 42
50459 KÖLN
Germany

— Access

http://www.eclassdownload.com

— Maintenance

http://www.eclass-serviceportal.com

A.3 Global Product Classification (GPC)

A.3.1 General

GPC is a global, multi-sector classification system for category management. GPC provides the granularity for a generic, global language for 36 segments.

— A way to organize information systems enabling internal and external data alignment.

— A sustainable, long term, integrated GS1® standard and the mandatory classification methodology in GDSN® (Global Data Synchronisation Network).

— GPC is translated into multiple languages and continues to introduce new languages.

GPC is a rules-based, four-tier classification system for grouping products. The four tiers are Segment, Family, Class, and Brick (with attributes). A Brick hosts those Global Trade Item Numbers (GTINs) grouped into the same category and serving a common purpose and application.

An example of the structure of GPC is shown in Figure A.2.

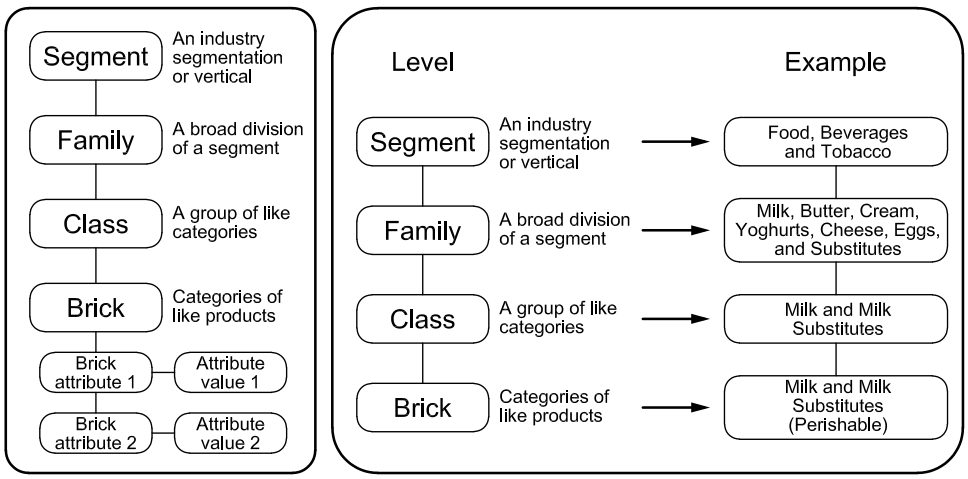

Figure A.2 — A four-tier hierarchy for milk

A Global Trade Item Number (GTIN) can only be assigned to one Brick.

A.3.2 Using attributes

Bricks can be further characterized by using attributes where required, see Figure A.3.

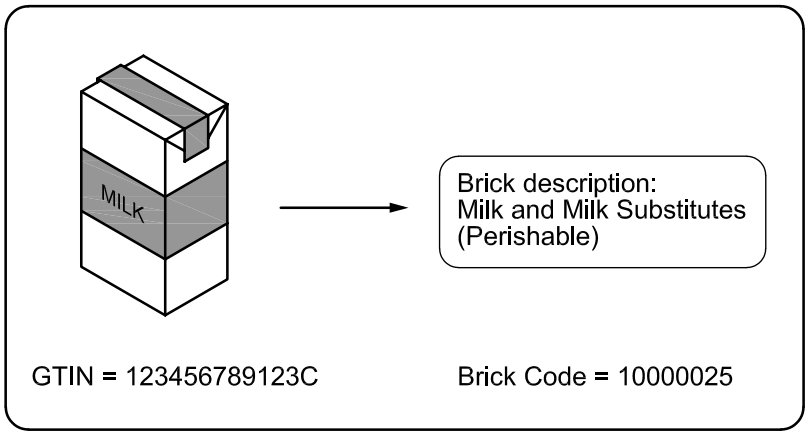

Figure A.3 — GTIN/Brick assignment

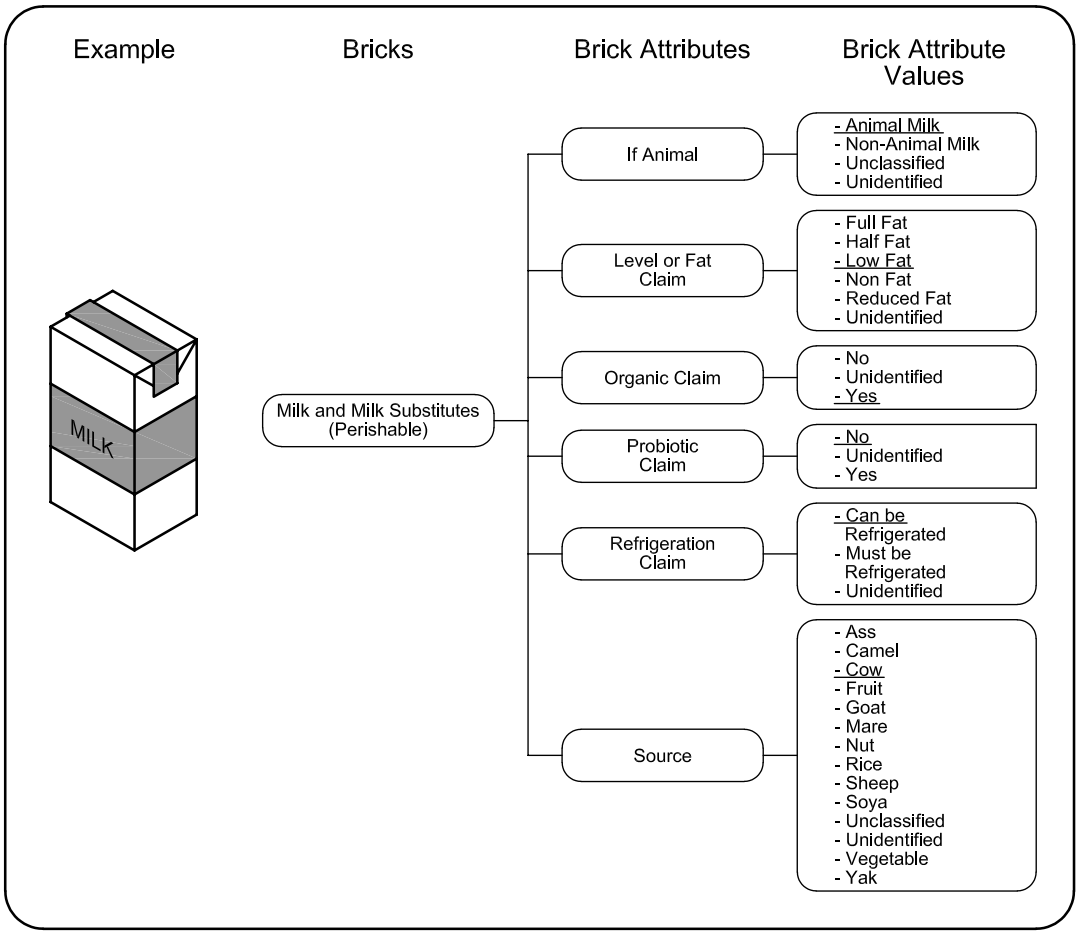

Figure A.4 — GPC Brick Attributes

Category-specific attributes and value pairs are specified at the Brick level.

Brick Definition: "Includes any products that can be described/observed as unflavoured **milk** derived from animals, such as cow, goat and buffalo, and vegetable-based **milk**, naturally derived from fruit or vegetables, such as coconut **milk** and almond **milk** or vegetable proteins such as soya **milk**. Products include those which have been inoculated with live acidophilus …"

GPC has 36 segments classifying a large variety of products such as electronic goods, building materials, home appliances and fast moving consumer goods (FMCG).

GPC has published over 3.000 defined product group bricks and over 11.000 brick attribute values that facilitate a powerful modular mix of many thousands of product category options.

GPC is part of GS1® standards and in line with GS1® General Specifications.

— Access

http://www.gs1.org/gdsn/gpc

— Maintenance

GPC is maintained under the GSMP (Global Standard Management Process), where all the queries and demand of a new development in GS1® standards are monitored to the users and routed to the appropriate Standard Management Group.

Annex B
(informative)

Rules for creating hierarchies of concepts and classes

Concepts are mental or logical representations of reality. In this sense all concepts are abstract and exist purely mentally, but they prepare a way for the human mind to classify and to understand the mind's perceptions. They are composed of characteristics. The "mental image" of reality is classified according to characteristics to enable the classification of other objects or concepts as the same, similar or different ones.

Guidelines a) to f) may be helpful for producing a well-structured hierarchy of concepts or classes.

a) The definition of the root concept of a concept hierarchy should cover the whole intention of the concept hierarchy. It should be valid for all the objects that may be characterized using this concept system.

b) Identify and list the most important or "general" concepts that, taken as a whole, make up the root concept. Arrange them at the first level below the root. These concepts should be distinguishable from each other by at least one characteristic.

c) Repeat step b) for each of the concepts below the root, to create the third level of the hierarchy.

d) Repeat step c) to create more levels of increasingly specific concepts, until the most specific concepts have been added.

e) Once the key concepts have been identified and ordered, relations should be added to describe relations among concepts. The most common types of relations are generic relations, partitive relations, and associative relations.

f) A further step is to look for concepts that may be borrowed from other domains and modified to express missing concepts. Thus, development effort may be saved and a greater homogeneity of the concept system may be achieved.

Once the concept system is complete, the classification system and its classes may be derived from it. In many cases, the classification system may be directly derived from the concept system by creating classes that directly correspond to their related concepts. If a class does not need to be as specific as its corresponding concept, it can be mapped to several concepts. If a more specific class is needed than what is available in the concept system, then the concept system should be extended to accommodate the related concepts.

In most cases, a classification system is intended to be used by humans. To address usability considerations, the system should not be more complex than can be supported by the intended user community. Thus, ergonomic aspects should be considered when designing the classification system. For ease of use, it is quite common to limit the number of hierarchical levels and the number of subclasses per class.

— It should be easy to determine in which branch and at which hierarchical level a certain class may be found.

— Concepts and classes should be mutually exclusive and thus appear only once.

— The number of branches at any level should be limited.

— The number of levels should be restricted.

— The number of concepts attached to any class should be small.

Different considerations may apply to concept systems and classification systems that are intended to be used by automated processes such as software applications, search engines, and so forth. These classification systems may be more complex than those intended for human users.

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