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Best Practices Guide for IT Vocabulary

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1 Scope

The purpose of this document is to provide a starting point for JTC 1 committees to understand key ideas and practices within terminology that are essential for writing good standards that are interpreted consistently, internationally.

Fundamentally, *terminology*[1] is less about *terms*, and more about *concepts*, *definitions*, *concept systems*, and their management. For Information Technology (IT), *designations* are a *broader concept* than terms, and designations such as *codes*, *code sets*, *symbols*, identifiers, etc., are also of interest to IT applications.

2 Why Terminology Is of Interest to JTC 1 and Its SCs/WGs

While updating the multi-part ISO/IEC 2382 standard and sharing knowledge of SC and WG culture, the following observations about terminology work in JTC 1 were noted:

- JTC 1's standards are developed only in English, which can cause problems as the standards are adopted nationally and translated into other languages. As an example, one committee was using/defining the English term "moniker", but its translation by some of the National Bodies (NBs) produced unacceptable results, so the term was changed to produce a different translation that had the consensus of the NBs.
- SC/WG participants frequently argue over the term (an incorrect belief in their own singular understanding of the word), rather than arguing over the concept and explaining what they mean by their concept and then later determining the spelling of the term that designates the concept (concept first, term second). The BPG makes recommendations to avoid these kinds of consensus-building challenges.
- Considering the backgrounds in overlapping expertise within the field of information technology, SC/WG participants approach terminology work from diverging points of views or diverging concept systems. As an analogy in biology, compare taxonomies of the animal kingdom based upon evolutionary/genetic similarity vs. morphological (form/structure) similarity — both are valid, yet they can produce incompatible concept system structures. These kinds of problems particularly arise in the development of IT code sets, indexes, classification, cataloguing, etc. where precise understandings are essential for interoperability in data sets, structures, services, etc. The BPG recommends better consensus-building strategies.
- Given the nature of IT and its technological development, some general words, e.g., interface, function, object, service, have many technical meanings. A common mistake is trying to define the word. The BPG recommends approaches to the terminological problems of narrow/broad concepts, and multiple concepts, e.g. the separate concept for function (in the mathematical sense) vs. function (a unit of code in a particular programming language).

3 An Illustration of Terminology Methods in Practice

A well known terminological problem serves as an illustration and analogy for problems that JTC 1 participants experience via technology evolution. In 2006, the International Astronomical Union (IAU) revised the definition of the concept of "planet". Its concerns were terminological in nature. Essentially, the IAU changed the *intension* of the definition (set of characteristics which make up the concept) when they discovered the older definition did not match the intended *extension* (totality of objects to which a concept corresponds):

> With the discovery during the latter half of the 20th century of more objects within the Solar System and large objects around other stars, disputes arose over what should constitute a planet. There was particular disagreement over whether an object should be considered a planet if it was part of a distinct population such as a belt, or if it was large enough to generate energy by the thermonuclear fusion of deuterium. A growing number of astronomers argued for Pluto to be declassified as a planet, since many similar objects approaching its size had been found in the same region of the Solar System (the Kuiper belt) during the 1990s and early 2000s. Pluto was found to be just one small body in a population of

[1] Key terms are marked with *italics* the first time they appear (see Bibliography). The word *terminology* has two meanings (i.e., two concepts, which implies two terms, even if they are spelled similarly):

terminology, **terminology science**: science studying the structure, formation, development, usage and management of terminologies in various subject fields

terminology: set of designations belonging to one special language

> thousands. Some of them including Quaoar, Sedna, and Eris were heralded in the popular press as the tenth planet, failing however to receive widespread scientific recognition. The discovery of Eris, an object 27 percent more massive than Pluto, brought things to a head. Acknowledging the problem, the IAU set about creating the definition of planet, and eventually produced one in 2006. The number of planets dropped to the eight significantly larger bodies that had cleared their orbit (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune), and a new class of dwarf planets was created, initially containing three objects (Ceres, Pluto and Eris). [See "http://en.wikipedia.org/wiki/Planet"]

Terminologically, the result was the splitting of the original *concept system* containing the single concept of "planet" into a new concept system containing two related concepts, "planet" and "dwarf planet" (both different than the original concept of planet), which caused the object Pluto to move from the extension of the original "planet" into the extension of "dwarf planet". The *intensional definition* contains 4 characteristics, i.e., "celestial body" plus the 3 enumerated characteristics:

> The definition of "planet" set in 2006 by the International Astronomical Union (IAU) states that in the Solar System a planet is a celestial body that: (1) is in orbit around the Sun, (2) has sufficient mass to assume hydrostatic equilibrium (a nearly round shape), and (3) has "cleared the neighbourhood" around its orbit. A non-satellite body fulfilling only the first two of these criteria is classified as a "dwarf planet".

In a similar way, standards committees develop and refine concepts (typically presented within standards in Clause 3, Definitions) as science, technology, and commercial areas evolve.

4 Concepts, Characteristics, Properties, and Designations

Characteristics are features of a concept that apply to all the objects corresponding to that concept. For example, the notion of "gaseous planet" (planet that is not primarily composed of rock or other solid matter) is a concept whose intension is broader than planet: the additional characteristic "not primarily composed of rock or other solid matter".[2] *Properties* are features of the concept's corresponding individual objects, e.g., weight is a characteristic for humans, but Moe weighs 80 Kg ("80 Kg weight" is a property of the object Moe with respect to characteristic "weight") and Larry weighs 90 Kg ("90 Kg weight" is a property of the object Larry).

Concept formation plays a pivotal role in organizing knowledge[3] because it provides the means for recognizing objects[4] and for grouping them into meaningful units in a particular field. Objects perceived as sharing the same properties are grouped into units. Once similar objects, or occasionally a single object, are viewed as a meaningful unit of thought within a branch of knowledge, the properties of an object or common to a set of objects are abstracted as characteristics which are combined as a set in the formation of a concept. In some cases, the characteristics are known first (e.g., mass) and properties are determined for individual objects (e.g., object A's mass is 5 Kg, while object B's mass is 10 Kg).

Formally, a concept is a unit of thought differentiated by characteristics; a characteristic is a concept that plays the role of a determinable (e.g., weight) in a determining relation; a property is a concept that plays the role of a determinant (e.g., 80 Kg) in a determining relation.[5] It is important to note that characteristics are associated with concepts (the intension), while properties are associated with the objects in the extension of the concept.

Characteristics are constantly being combined in order to create concepts, although differently in different cultures, fields, or schools of thought. The combination of unique sets of characteristics is represented in special language by a designation (i.e., a term, *appellation*, or symbol). The methodology used in the analysis of terminologies

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[2] Although it might appear that there is some set theory and corresponding set operations between intension and extension ("red automobile" is the set of "all automobiles painted red"), this is not the case in general.

[3] The notion of *knowledge* here is used in its broadest sense, i.e., what is *known* but not necessarily proven to be true. In this broad sense, *knowledge* also includes statements that are known, e.g., *2+2=5*, but obviously false. Determining what is true/false is outside the scope of this document. In many practical applications of the terminologies, stronger assertions of truth are necessary, e.g., a data element for Date-Of-Birth actually corresponds to the person's birth date.

[4] **object**: anything that may be perceived or conceived. Perceivable objects include automobile, light, minerals, bacteria (via the microscope *assistive device*), and voltage (via the voltmeter *assistive device*). Conceivable objects, include the real world (the formula $E=mc^2$) and the imaginary world (unicorns). It is possible to create data about the imaginary

requires identifying the context or subject field in question, identifying the properties attributed to objects in the subject field, determining those properties which are abstracted into characteristics, and then combining the characteristics to form a concept (which differentiate this unit of thought from other units of thought). It may be useful to begin an analysis with those concepts corresponding to concrete objects, since the characteristics are more easily abstracted given that the properties of the objects can be physically observed or examined. Properties should be ascribed only to objects.

Knowing the context of the subject field will greatly help determine and define the concept. For example, a pencil might be used in the subject field of office supplies or the subject field of musical instruments and the choice of subject field might produce different definitions: "a writing instrument consisting of a wooden barrel that encases a graphite core" vs. "a percussive instrument, similar to drum stick, but with at least one rubber end". Characteristics should be used in the analysis of concepts, in the modeling of concept systems, in the formulation of definitions and, as often as possible, in the formation of designations. The set of characteristics that come together as a unit to differentiate the concept is called the intension. The objects viewed as a set and conceptualized into a concept are known as the extension. The two, *intension* and *extension*, are interdependent. For example, the characteristics making up the intension of "lead pencil" determine the extension, those objects that qualify as lead pencils and vice versa.

This interplay of intension (characteristics) and extension (their corresponding objects) is important for determining precise definitions of concepts. When defining a concept, for a given intension, one can imagine the corresponding objects in the extension; if the set of objects inside the extension correspond to the concept and the set of objects outside the extension do not correspond to the concept, then one has arrived at a candidate definition; otherwise, the intension needs to be revised/refined to correctly correspond to the intended set of objects[5]

5 Definitions

5.1 Essential Characteristics

Not all characteristics are equally important. For practical purposes, the *essential characteristics* of the intension shall be the focal point of any analysis and may differ according to specific fields. Characteristics are considered essential if they are indispensable for the understanding of the concept in a particular field of knowledge: the absence of an essential characteristic fundamentally changes the concept. The absence of an essential characteristic in the course of an analysis will lead to a poor or even erroneous understanding of the concept. In the example of the "lead pencil", if the characteristic “graphite core is encased in wood” were removed, the concept would be radically changed. It would represent a different concept corresponding to a different set of objects. Therefore, this is an essential characteristic. On the other hand, if the characteristic “one end may be sharpened to a point” were removed, the concept would not be altered. Although a lead pencil must be sharpened in order to write, it still qualifies as a lead pencil even if it has not been sharpened. Therefore, this characteristic is not essential to the understanding of the concept of "lead pencil".

5.2 Delimiting Characteristics

After identifying the essential characteristics that make up the intension of a concept, the terminological analysis shall be taken a step further. Each essential characteristic of the concept under study shall be analyzed in relation to the related concepts in the concept system. Common or shared characteristics indicate similarities between

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world, e.g., a statistically valid survey asking children how many legs a unicorn has. For IT, the distinction between perceivable and conceivable objects is in designations: signifiers (also known as "signs", which are perceivable objects) that designate concepts (whose extension is any kind of object); a datum (the singular of data) is a kind of designation: the signifier (numeral, identifier, etc.) designates a concept (number, code value, etc.).

5 This explanation might seem circular in that characteristics are defined as a kind of a concept and the definition of concept uses characteristics, but there is no circularity. Characteristics and properties are kinds of concepts. A concept is a unit of thought (i.e., it is not a characteristic itself), but these units of thought are differentiated by other units of thought of a special kind (characteristics). In other words, concepts are not comprised of characteristics, they are differentiated by characteristics.

[5] Best practices suggest that it is important to undertake this kind of interplay exercise at this step as it helps to validate and refine the definitions.

concepts; delimiting characteristics signal differences that set concepts apart. A *delimiting characteristic* is an essential characteristic that distinguishes one concept from another. However, delimiting and common are relative terms. The same essential characteristic may be delimiting in relation to one concept but common in relation to another related concept. Analyzing the similarities and differences between concepts will result in the unique set of characteristics that typify a given concept. This unique combination of characteristics will situate the concept within a network of related concepts with similar or different characteristics. The relations between the concepts shall be used to determine the basic structure of the concept system. Understanding the characteristics used to develop the concept system simplifies the task of defining a concept.
A definition should define the concept as a unit with a unique intension and extension. The unique combination of characteristics creating the intension should identify the concept and differentiate it from other concepts. The quality of most terminologies will be determined by the quality of the definitions. A definition might be complemented by a note or a graphic representation.

5.3 Intensional Definitions

Intensional definitions indicate the superordinate concept, either immediately above or at a higher level, followed by the characteristic(s) that distinguish the concept from other concepts. The superordinate concept situates the concept in its proper context in the concept system (e.g., pencils among writing instruments, trees among plants). In practice, intensional definitions are preferable to other concept descriptions. Intensional definitions should be used whenever possible as they most clearly reveal the essential characteristics of a concept within a concept system. The intensional definition should be based on the concept relations determined during analysis.

EXAMPLE 1 Generic Relation: By stating the generic concept, the characteristics that make up the intension of the superordinate concept are implicitly assumed in the definition, e.g. a "pencil" is a "writing instrument (superordinate concept) that (list of delimiting characteristics ...)"

EXAMPLE 2 Partitive Relation: Partitive definitions typically begin with formulations that clearly indicate the partitive relation, such as: part of, component of, section of, period of, element in, ingredients making up, etc., followed by the superordinate concept (i.e., the comprehensive concept) and the delimiting characteristics, e.g., a drive train is a "part of an automobile (comprehensive concept) that (list of delimiting characteristics ...).

5.4 Extensional Definitions

In highly specialized terminological documents directed at field specialists, the definition can be formulated as a list of the subordinate concepts, in only one dimension, that correspond to objects making up the extension of the concept (e.g., noble gas: helium, neon, argon, crypton, xenon or radon). It is important to remember that the extension is not the same as an *extensional definition*. The list stands for concepts that depict the objects making up the extension and not the objects themselves. Extensional definitions are to be used only when intensional definitions are difficult to elaborate.

In particular to IT and data descriptions, intensional definitions might be used when the value space is very large or infinite, e.g., the datatypes of integers and real numbers describe their value spaces using (mathematical) characteristics that describe the value space (i.e., the extension of the concept). In some data descriptions where a general description is difficult or impractical, extensional definitions might be used to describe the elements of the value space, e.g., a value space containing the notions of Male and Female, or another value space containing the notions of Single, Married, Widowed, Divorced.

5.5 Principle of Substitution[6]

The substitution principle shall be used to test the validity of a definition. A definition is valid if it can replace a designation in a text without loss of or change in meaning. For example, in the sentence "the metadata was stored in the repository", its definition can be substituted for the word "metadata", giving "the descriptive data about an object was stored in the repository".

[6] See further ISO10241-1:2011 *Terminological entries in standards – Part 1 General requirements and examples of presentation*, in particular its Clause 41. "*General principles*", and Clause 6.4.5 "*Applying the principle of substitution*".

6 Terminological Data

ISO 10241-1:2011 should be consulted for providing the right degree of data for terminological entries. Terminological data include elements such as: Entry Number, Terms, Preferred Terms, Admitted Terms, Deprecated Terms, Letter Symbol, Definition, Notes, Examples, and Source.

7 Access to Concept and Terminology Databases

In Jeju JTC 1 Resolution 15, the use of the ISO Online Browsing Platform (OBP), Electropedia and the IEC Glossary is recommended: *"JTC 1 notes that many SCs are developing vocabulary/ontology. JTC 1 reminds SCs that they must recognize and defer terminology to that defined by JTC 1 SCs and other entities with technology specific charters and expertise. JTC 1 entities are encouraged to consult the ISO OBP, Electropedia and the IEC Glossary before defining terms. This will avoid the confusion that can arise when a term is defined but that particular term is already well established in similar environments with a slightly different definition. ..."*. (JTC 1 N11429, 2012-11-15)

8 Bibliography

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[7] ISO/IEC 2382 is currently waiting IS publication in database format, i.e., a stage 60.00.