Ontology Definitions in International Standards and the Issues for Harmonization

Virtual International Seminar

Terminology and Ontology Harmonization: the ISO point of view.
Illustration with the ISO 860 Standard

Prof Christophe Roche
University Savoie Mont-Blanc (France)
University of Liaocheng (China)

http://christophe-roche.fr/
Abstract

If everybody agrees to say that ontology is at the core of the digital society, it remains to agree on what ontology is. For example, the ISO standards offer more than forty definitions of ontology ranging from a conceptual system to a structured vocabulary. However, while we can agree on a definition of ontology, ontologies in the same domain may differ and need to be harmonized.

There are different approaches, methods and techniques for ontology-terminology harmonization (including ontology-terminology alignment) ranging from a linguistic one focusing on terms to a conceptual one focusing on concepts and their relationships.

These issues will be studied from the point of view of ISO on Terminology where a term is a verbal designation of a concept, and a concept is a unique combination of characteristics. This talk will be illustrated with the ISO 860 Standard on “Harmonization of concepts and terms”.

Contents

1) Harmonization
2) Definitions of Terminology in ISO Standard
3) Definitions of Ontology in ISO Standard
4) Definitions of Concept in ISO Standard
5) Which Definitions?
6) Harmonization: The ISO 860 Standard
7) Conclusion
1) Harmonization

"Make consistent or compatible"

*Oxford Dictionary*

- Definition of Terminology?
- Definition of Ontology?
  → definition of Concept?

- Harmonization of Terminologies?
- Harmonization of Ontologies?

ISO 860:2007
Terminology work —
Harmonization of concepts and terms
2) Definitions of **Terminology** in the ISO Standards

ISO Online Browser Platform (OBP)

[Image of ISO Online Browser Platform (OBP) search results for "terminology"]

**Definitions**

- **Terminology**: Language, words and terms used in a specific domain. (ISO/TS 22287:2019(en), 3.20)
  - Available in: EN

- **Terminology**: Set of designations belonging to one special language. (SOURCE: ISO 1087-1:2006)
  - ISO 16278:2016(en), 2.9
  - Available in: EN, FR

- **Terminology**: Any organized set of codes, including the entities commonly referred to as “code sets”, “ontologies”, “vocabularies”, “classification systems”, etc. (ISO/IEC 23791:2009, 3.9)
  - Available in: EN

  - Available in: EN

- **Terminology**: Set of designations belonging to one special language. (SOURCE: ISO 10971-12:2009, 2.3.1)
  - ISO 16278:2016(en), 3.26
  - Available in: EN

**URL**

https://www.iso.org/obp/ui#search
2) Definitions of **Terminology** in the ISO Standards

- set of **designations** belonging to one **special language** – ISO 1087-1: 2000

  language used in a **subject field** and characterized by the use of specific linguistic means of expression

  field of special knowledge

- any organized set of codes, including the entities commonly referred to as "code sets", "ontologies", "vocabularies", "classification systems", etc. - ISO/HL7 27951:2009, 3.9


- concept representation system - ISO 17117-1:2018(en), 3.4.2

- structured, human readable, and machine-readable representation of concepts - ISO/TR 12300:2014(en), 2.2.9
2) Definitions of **Terminology** in the ISO Standards

The main purpose of this document is to provide a systematic description of the concepts related to terminology work and terminology science and to clarify the use of the terms in this field.

### 3.1.4 domain
subject field
field of special knowledge

### 3.1.5 subject
area of interest or expertise

### 3.4.1 designation
designator
representation of a *concept* by a sign which denotes it in a *domain* or *subject*

### 3.4.2 term
designation that represents a *general concept* by linguistic means

### 3.1.11 terminology
set of *designations* and *concepts* belonging to one *domain* or *subject*
3) Definitions of **Ontology** in the ISO Standards

ISO Online Browser Platform (OBP)

- **Ontology**
  - Formal representation of a set of concepts within a domain and the relationships between those concepts.
  - Note 1 to entry: Ontologies are usually used to reason about the properties of that domain, and can be used to define the domain.
  - Note 2 to entry: Ontologies are usually expressed in a logic-based language, but this is not a requirement, neither is the need for reasoning capability. In addition to relationships, classes, properties, instances and axioms can be used.
  - ISO/TS 15926-8:2011(en), 2.1.21
  - Available in: EN

- **Ontology**
  - explicit and consensual specification of concepts of an application domain independent of any use of these concepts.
  - Note 1 to entry: In ISO 13584, a dictionary is the formal and computer-sensible representation of ontology.
  - ISO 13584-511:2006, 3.1.20
  - Available in: EN

- **Ontology**
  - explicit and consensual specification of concepts of an application domain independent of any use of these concepts.
  - Note 1 to entry: In the ISO 13399 series, a dictionary is the formal and computer-sensible representation of an ontology.
  - Available in: EN, FR

- **Ontology**
  - specification of concrete or abstract things, and the relationships among them, in a prescribed domain of knowledge.
  - [SOURCE: ISO/IEC 19763-3:2010, 3.1.1.1]
  - Note 1 to entry: An ontology is formal and explicit specification of a shared conceptualisation. (See Bibliography)
  - ISO/IEC TR 20943-6:2013(en), 3.2.1
  - Available in: EN

[https://www.iso.org/obp/ui#search](https://www.iso.org/obp/ui#search)
3) Definitions of **Ontology** in the ISO Standards

- “**a conceptualisation of a domain**” - ISO/TS 21526:2019(en), 3.36 - Health informatics

- “organization of concepts for which a rational argument can be made” - ISO/TR 13054:2012(en), 2.6

- “explicit and consensual specification of concepts of an application domain independent of any use of these concepts” - ISO 18435-3:2015(en), 3.1

- “specification of concrete or abstract things, and the relationships among them, in a prescribed domain of knowledge” - ISO 37105:2019(en), 3.2

- “organization of concept for which a rational argument can be made” - ISO/TR 12300:2014(en), 2.1.15

- “specification of concrete or abstract things, and the relationships among them, in a prescribed domain of knowledge” - ISO/IEC 19763-1:2015(en), 4.1.20

- “**logical structure of the terms used to describe a domain of knowledge, including both the definitions of the applicable terms and their relationships**” (3.47) - ISO 20534:2018(en), 3.36

- “**formal representation of phenomena of a universe of discourse (3.1.23) with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships**” - ISO 19150-4:2019(en), 3.1.19

- ...

- “**formal, explicit specification of a shared conceptualization**” - ISO 5127:2017(en), 3.1.2.03 - Information and documentation — Foundation and vocabulary

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

- ...

- “**a lexicon of specialised terminology along with some specification of the meaning of terms in the lexicon**” - ISO 18629-42:2006(en), 3.1.11 - Industrial automation systems and integration
3) Definitions of **Ontology** in the ISO Standards

Not defined in the ISO 1087

“An ontology is a shared description of **concepts** and relationships of a domain expressed in a formal and computer readable language”

C. Roche
4) Definitions of Concept in the ISO Standards

ISO Online Browser Platform (OBP)

- 59 results for concept
  - ISO 20534:2018(en)
  - ISO 19150-4:2019(en)
  - ISO 5127:2017(en)
  - ISO/TS 21526:2019(en)
  - ISO 18308:2011(en)

Definitions:

- Concept: unit of knowledge created by a unique combination of characteristics.
  - ISO 1087:2000, 3.2.1
  - ISO 13940:2015(en), 3.2.1
  - ISO 18308:2011(en), 3.15

- Concept: unit of knowledge created by a unique combination of characteristics (ISO 1087:2000, 3.2.4)
  - ISO 10241-2:2012(en), 2.4.1.1

Note 1 to entry: Concepts are not necessarily bound to particular languages. They are, however, influenced by the social or cultural background, which often leads to different categorizations.

- Concept: unit of knowledge created by a unique combination of characteristics (3.1.3)
  - ISO 1087:2000, 3.2.1
  - ISO 19146:2018(en), 3.1.4
4) Definitions of **Concept** in the ISO Standards

**unit of knowledge created by a unique combination of characteristics**


- abstract entity for determining category membership

  ISO/IEC 2382:2015(en) Information technology — Vocabulary
4) Definitions of **Concept** in the ISO Standards

The main purpose of this document is to provide a systematic description of the concepts related to terminology work and terminology science and to clarify the use of the terms in this field.

3.1.3 **property**
feature of an *object*

3.2.1 **characteristic**
abstraction of a *property*

3.2.3 **essential characteristic**
*characteristic* of a *concept* that is indispensable to understand that concept

3.2.7 **concept**
unit of knowledge created by a unique combination of *characteristics*
5) Which Definitions?

**Terminology**

3.1.11 **terminology**
set of *designations* and *concepts* belonging to one *domain* or *subject*

3.2.7 **concept**
unit of knowledge created by a unique combination of *characteristics*

**Ontology**

An ontology is a shared description of *concepts* and relationships of a domain expressed in a formal and computer readable language.

- Concept? Class?
  - Theory of Knowledge?
  - W3C?

*Unit of knowledge about a plurality of things sharing a common property?*

*concepts* are expressed in a formal and computer readable language.
6) Harmonization

"Make consistent or compatible"  
*Oxford Dictionary*

A term is a verbal designation of a concept

---

Ontology

Alignment

Ontology
6) Harmonization: Ontology Alignment

1. Terms
A term is a verbal designation of a concept.

2. Extensions
A concept is a knowledge about a plurality of things.

3. Attributes
A concept is defined as a unique combination of characteristics.

4. Relationships
Concepts are linked into a structured system.

(\( C_i, C_j, R, m \))

\( R: \equiv, >, \cap, \perp \)

\( m: \) similarity measure
6) ISO 860:2007
Terminology work — Harmonization of concepts and terms

This standard was last reviewed and confirmed in 2016.
Therefore this version remains current.
6) ISO 860:2007

Terminology work — Harmonization of concepts and terms

This standard was last reviewed and confirmed in 2016. Therefore this version remains current.

Abstract

ISO 860:2007 specifies a methodological approach to the harmonization of concepts, concept systems, definitions and terms. It applies to the development of harmonized terminologies, at either the national or international level, in either a monolingual or a multilingual context.

Harmonization starts at the concept level and continues at the term level.

Concepts shall be analysed by comparing their characteristics and not their designations.
6) ISO 860:2007 Harmonization of concepts and terms

Concept harmonization

activity leading to the establishment of a correspondence between two or more closely related or overlapping concepts having professional, technical, scientific, social, economic, linguistic, cultural or other differences, in order to eliminate or reduce minor differences between them

Similarity between concepts

a) which characteristics the concepts of each concept system have in common
   1) within a language,
   2) across languages;

b) which characteristics of the concepts differ from one concept system to another
   1) within a language,
   2) across languages;

c) which characteristics are essential to each key concept.
Harmonization procedure

All relevant concept systems shall be examined. Ideally, a new set of concept systems, containing all the material from all the sources to be harmonized, will be produced.

6) ISO 860:2007 Harmonization of concepts and terms
6) ISO 860:2007 Harmonization of concepts and terms

4.2 Feasibility study

4.2.1 Preliminary analysis

Before conducting concept harmonization, differences and similarities between concepts and concept systems shall be examined in order to determine the feasibility of harmonization. Preliminary issues will be concerned with whether the concept systems to be harmonized are from the same subject field, the extent to which both contain the same concepts and, if the content is overlapping, whether the harmonization project is to be directed towards the area of overlap, or all the concepts in the systems to be harmonized.

The comparative analysis of the different concept systems shall take account of the following:

a) the number of concepts included;
b) the relationships between concepts;
c) the depth of structuring;
d) the criteria of subdivision used to develop the concept system.
ISO 860: The concept harmonization process

1. Preliminary issues (4.2.1)
   - Are concept systems from the same subject field?
     - No
     - Analysis of subject field (4.2.2)
     - Analysis of similarities between concepts (4.2.3)
       - Are chances for harmonization good?
         - No
         - Do not harmonize
         - Analysis of concepts systems (4.3.2)
           - Comparison of single concepts (4.3.4)
             - Are the same characteristics used to define the concepts?
               - Yes
               - Draft harmonized definition (6)
               - End
             - No
             - Is there a partial overlapping of the concept?
               - Yes
               - Draft definition for concept that exists in one concept system but not in another (6)
               - Harmonize the concepts (4.3.4.3.1)
               - Draft harmonized definition (6)
               - Are there more concepts to be harmonized?
                 - Yes
                 - Draft harmonized definition (6)
                 - End
               - No
               - Are differences minor?
                 - Yes
                 - Draft harmonized definition (6)
                 - End
                 - No
                 - Are concept systems from the same subject field?
                   - No
                   - Analysis of subject field (4.2.2)
                   - Analysis of similarities between concepts (4.2.3)
                     - Are chances for harmonization good?
                       - No
                       - Do not harmonize
                       - End
         - Yes
         - Harmonize the concepts (4.3.4.3.1)
         - Draft harmonized definition (6)
         - Are there more concepts to be harmonized?
           - Yes
           - Draft harmonized definition (6)
           - End
           - No
ISO 860: The concept harmonization process

1. Preliminary issues (4.2.1)
   - Are concept systems from the same subject field?
   - Analysis of subject field (4.2.2)
   - Analysis of similarities between concepts (4.2.3)
2. Analysis of concepts systems (4.3.2)
   - Are chances for harmonization good?
3. Comparison of single concepts (4.3.4)
   - Are the same characteristics used to define the concepts?
     - Yes
     - No
   - Is there a partial overlapping of the concept?
     - Yes
     - No
4. Differences minor?
   - Yes
     - Harmonize the concepts (4.3.4.3.1 a)
     - Draft harmonized definition (5)
   - No
     - Do not harmonize (4.3.4.3.1 b)
     - Draft separate definitions
5. Draft harmonized definition (5)
6. Are there more concepts to be harmonized?
   - Yes
   - No

End
7) Conclusion

Alignment more than Harmonization