Problems of terminology consistency in international standards and guidelines: some case studies and concept diagrams

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In the scientific and technical arenas, the first must is a common understanding of the basic concepts and terms in scientific and technical, otherwise impossible.

There are several bodies historically devoted to achieve this goal, national and international, sectorial and general, prescriptive and advisory.

Some efforts have been spent in the last 1-2 decades to create such shared understanding, and improve the efficiency of this frame. The Joint Committee for Guides on Metrology established two advisory Committees (formed by representatives of BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML), one for defining concepts and associated terms and one on measurement uncertainty. The ISO, with IEC probably the major body on prescriptive standards, recently set up a database of terms used within ISO standards, of which the guides produces by the above mentioned Committees are part.

In the paper, some case studies are reported, in order to illustrate problems encountered and the method intended for use within IMEKO TC21 to facilitate solutions.

For example, one of these concerns a 'family' of concepts centred on "trueness". 28 entries were found in the ISO database, out of a total of 32 entries on "(measurement) trueness" presently collected in TC21 repository. Each definition involves also other terms, which can, in turn, have several definitions, or can have had different forms in the past. A total of 70 definitions are presently collected and inter-related under "trueness" main heading in the TC21 repository. In addition, two concept diagrams are presently built under "trueness" from these definitions.

A first type of definitions of "trueness" uses the term "true value":
• ISO 3534-2:2006 (3.3.3): "Closeness of agreement between the expectation of a test result or a measurement result and a true value. (& ISO/TS 13530:2009)
NOTE 1 The measure of trueness is usually expressed in terms of bias; NOTE 2 Trueness is sometimes referred to as "accuracy of the mean". This usage is not recommended; NOTE 3 In practice, the accepted reference value is substituted for the true value.
• ISO 14111:1997 (3.4.2): "The closeness of agreement between the average value obtained from a large series of measurement results and the true value of the measurand." (& ISO 14532:2001; ISO 15189:2003; ISO 17511:2003; ISO 15971:2008; ISO 19003:2006)
• ISO 15195:2003 (3.10): "Closeness of agreement between the average value obtained from a large series of results of measurements and a true value" (& ISO 15189:2007)

A second type of definitions of "trueness" uses the term "reference value":
• ISO 3534-1:1993 (3.12): "The closeness of agreement between the average value obtained from a large series of test results and an accepted reference value" (& A2LA Guide:2002;, ISO 5725-1:1994; ISO 6107-8:1993; ISO 11459:1997; ISO 15198:2004; ISO 15197:2003; ISO 17294-1:2004; ISO/TS 21748:2004; ISO 11726:2004; ISO 24276:2006; ISO 11885:2007; ISO 17593:2007; ISO Guide 33:2000; ISO/IEC Guide 43-1:1997; ISO/TS 13530:2009)
• VIM3 JCGM200:2008 (2.14): "Closeness of agreement between the average of an infinite number of replicate measured quantity values and a reference quantity value.
NOTES: 1 — Measurement trueness is not a quantity and thus cannot be expressed numerically, but measures for closeness of agreement are given in ISO 5725. 2 — Measurement trueness is inversely related to systematic measurement error, but is not related to random measurement error. 3 — Measurement accuracy should not be used for 'measurement trueness' and vice versa.

• ISO DIS 21748:2008 (3.11): "Closeness of agreement between the average value obtained from a large set of test results and an accepted reference value.

NOTE The measure of trueness is normally expressed in terms of bias. The

reference to trueness as 'accuracy of the mean' is not generally recommended."

• EA 4/16:2003 (6.3.1): "Measured as bias with respect to a known reference value"

The main embedded terms (and entries in ISO database) were found to be: "True value" (29 entries); "(Accepted) reference value" (19 entries); "Test or measurement result" (23 and 11 entries); "Accuracy" (180 entries); "Bias" (122 entries); "Systematic effect" (2 entries); "Systematic error" (26 entries); "Systematic uncertainty" (5 entries); "Definitional (intrinsic) uncertainty" (1 entry); "Correction" (18 entries); "Expectation" (3 entries).

Concerning the most important one, "true value", 32 entries in total are presently included in TC21 repository. For the other most important, "reference value", 22 entries in total are presently included in TC21 repository. Two concept diagrams are also presently included.

The paper aims at illustrating the study under way in IMEKO TC21, based on the contents of the repository, which is a broader collection of documents with respect to the ISO database, intended to look specifically to what looks, often obviously, as inconsistencies.

An effort is being made to understand why, and whether they are due to historical stratification or to sound reasons (e.g. sectorial), and to find and suggest ways toward reducing their number –not necessarily toward a single set of meanings for the concepts and terms, but limited, in addition to their general meaning, to real and undisputable sectorial needs.