Some significant changes

JCGM/WG2 webinar:
An overview of the VIM4

6 May 2021

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Joint Committee for Guides in Metrology (JCGM)
Working Group on the International Vocabulary of Metrology (VIM) - WG2

Some significant changes…

… from the VIM3 to the VIM4 CD

Together with many smaller or more specific changes, coordinated revision of the entries about:

1. properties, thus including quantities and nominal properties

2. measurement accuracy, error, etc

3. examination of nominal properties (→ Gunnar Nordin)

… as presented in "Significant changes of the VIM4 with respect to the VIM3"

1. Properties: general and individual

The object of measurement are **properties**, and more specifically quantities

The terms "quantity", "ordinal quantity", and "nominal property" refer to both things like length and blood group (**properties in the general sense**) and things like given lengths and given blood groups (**individual properties**)

The distinction is simple but fundamental:

- comparisons, by equivalence, order, or ratio, apply to *individual* properties
- measurements are about *individual* properties
- the distinction base vs derived quantities is about *general* quantities
- ...

$\rightarrow$ ***individual* properties are instances of *general* properties**

The terminological choice

Introducing this distinction would make the Vocabulary clearer and more consistent, but one term "property" is used for both general and individual properties (e.g., length is a quantity; the length of this rod is a quantity)

ISO/IEC Directives: "If a term is used to define more than one concept, a separate terminological entry shall be created for each concept and the domain shall be included in angle brackets before the definition."

1.1 **quantity <general>**
general quantity
quantity in the general sense
kind of quantity

property whose instances can be compared by ratio or only by order

1.2 **quantity <individual>**
individual quantity

instance of a general quantity

Three key benefits

quantity
property of a phenomenon, body, or substance,
where the property **has a magnitude that can
be expressed as a number and a reference**

quantity <general>
property whose instances
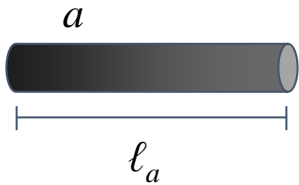**can be compared by ratio or only by order**

References to the concept 'magnitude' are avoided

Definitions are based on operational concepts

The equation   **measurand = measured value**
is provided with a simple interpretation

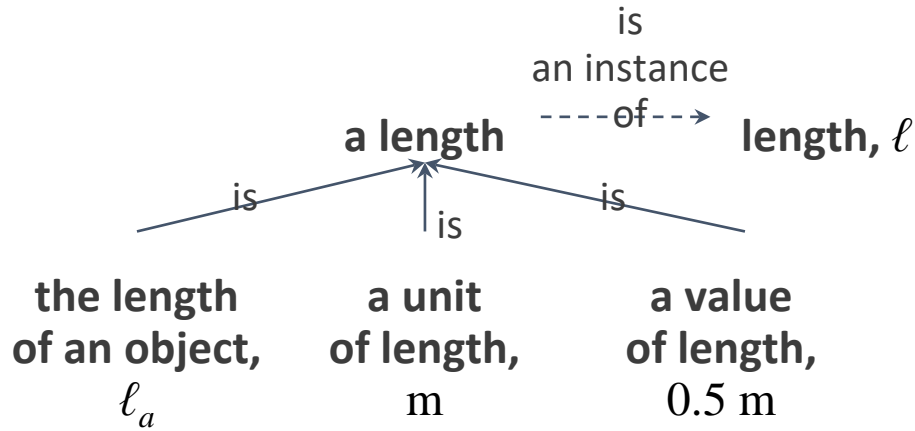# Interpreting measurand = measured value

Given ![length a] the equation $\ell_a = 0.5 \text{ m}$ is meant that

there is an individual length called "the metre"
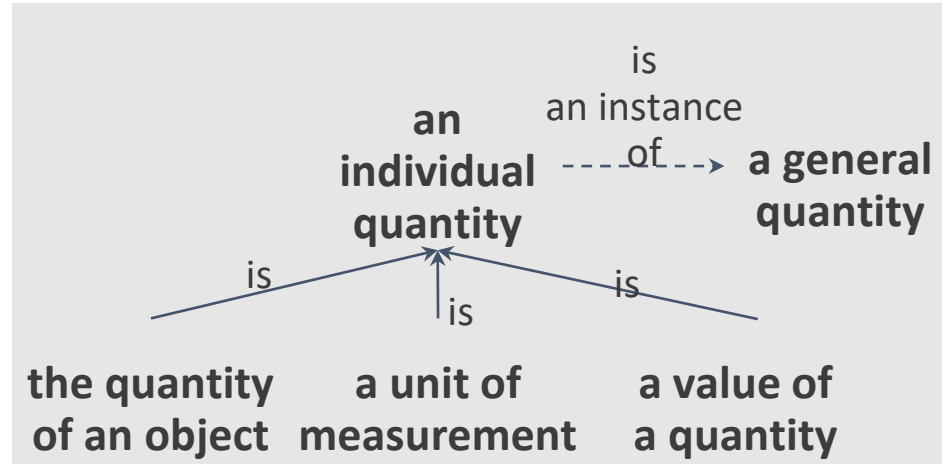
such that $\dfrac{\ell_a}{\text{m}} = 0.5$ and therefore that ℓ_a and 0.5 m are the same length

and therefore that **both units of length and values of length are lengths**, and therefore individual quantities

Interpreting measurand = measured value

is
an instance
----of-->

a length **length,** ℓ

is   is   is

**the length
of an object,**
ℓ_a

**a unit
of length,**
m

**a value
of length,**
0.5 m

and therefore

is
an instance
of -->

**an
individual
quantity** **a general
quantity**

is   is   is

**the quantity
of an object** **a unit of
measurement** **a value of
a quantity**

Consequence: some VIM4 CD definitions

1.9 **measurement unit**
unit of measurement
unit

real scalar **individual quantity**, defined and adopted by convention, with which any other quantity of the same kind can be compared by ratio, resulting in a number

1.20 **value of a quantity**
quantity value
value <quantity>

individual quantity identified as the product of a number and a measurement unit or on an ordinal scale

1.19 **measurement scale**

ordered set of **individual quantities** of the same kind, where each quantity is associated with an element of a set of ordered identifiers
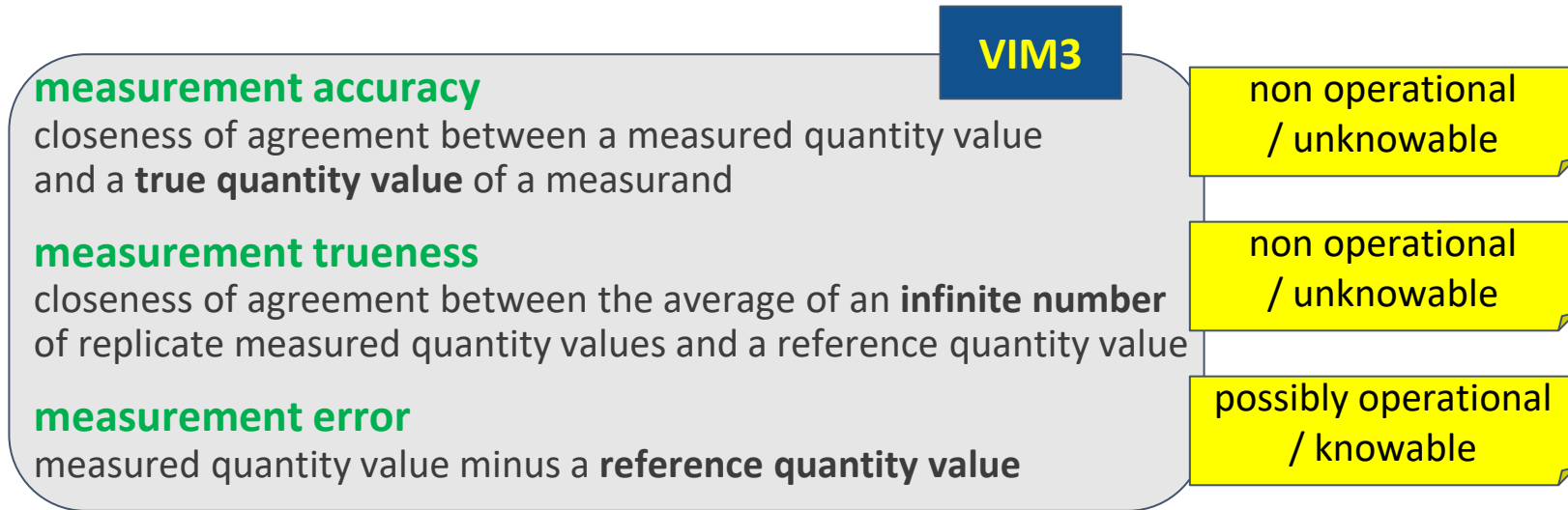
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2. Measurement accuracy, error, etc

The VIM3 defines the three key features of **measurement accuracy**, **measurement trueness**, and **measurement error** according to a hybrid approach

VIM3

measurement accuracy
closeness of agreement between a measured quantity value and a **true quantity value** of a measurand

non operational / unknowable

measurement trueness
closeness of agreement between the average of an **infinite number** of replicate measured quantity values and a reference quantity value

non operational / unknowable

measurement error
measured quantity value minus a **reference quantity value**

possibly operational / knowable

Furthermore, the VIM3 remains silent whether these features refer to measurements, or measurement procedures, or measurement results, or measured values, or …

An operational approach

The VIM4 acknowledges that measurement accuracy etc may be of measurement, measurement results, etc, and in some cases they **may be known**, also in a quantitative sense

Accordingly, the approach has been followed to adopt **operational definitions** whenever possible, consistently in particular with the position of ISO 5725 [*]

'measurement accuracy' etc are defined about reference values, of which true values are specific cases

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[*] ISO 5725 Accuracy (trueness and precision) of measurement methods and results

Consequence: some updated definitions

measurement accuracy
closeness of agreement between a measured quantity value and a **true quantity value** of a measurand

measurement trueness
closeness of agreement between the **average of an infinite number of replicate measured quantity values** and a reference quantity value

measurement error
measured quantity value minus a reference quantity value

measurement accuracy
closeness of agreement between a measured value and a **reference value** of a measurand

measurement trueness
closeness of agreement between the **average of measured values obtained by replicate measurements** and a reference value

measurement error
measured value minus a reference value

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