An improved visual description of the VIM

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An improved visual description of the VIM

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Abstract. All the sciences and several disciplines have their own vocabulary, and metrology is not the exception. The international vocabulary of metrology (VIM) includes an annex with concept diagrams which represent most of the relations among the concepts defined in the main text of the vocabulary. Even when these diagrams follow international standards, they are usually confusing and sometimes hard to understand. OSSAD (Office System Support Analysis and Design) is a visual language that has been used to document management systems and has its own structure, syntax and grammar. Visual representation through OSSAD of originally blurred textual procedures has proved its usefulness in translating text into visual diagrams easy to understand for inexperienced users. The adaptation of OSSAD to visually description of the VIM is showed in this paper. A comparative analysis between the current concept diagrams and the proposed ones was done. The visual language has allowed the mapping of complex relationships between VIM concepts in a more natural way, and the results of a questionnaire suggest that comprehension of metrology terminology in classroom has been improved with the OSSAD visual description of the VIM.

1. Introduction

One of the functions of terminology is the representation of concept systems using concept diagrams. A concept diagram could be defined as [1] "a graphic representation of a set of units of knowledge, created by a unique combination of abstractions of a property of anything perceivable or conceivable, and structured according to the relations among them", i.e., the graphic representation of a concept system.

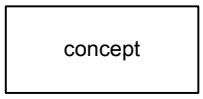
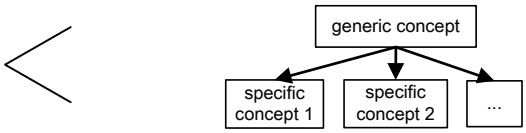
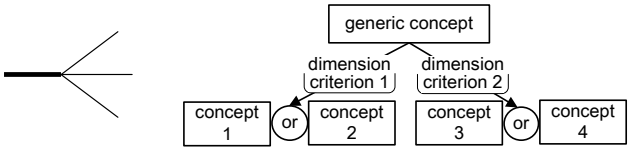
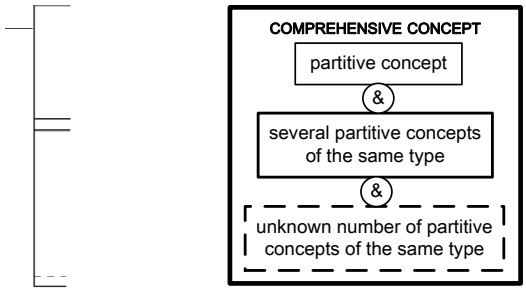
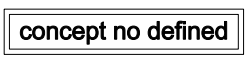
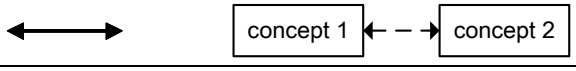
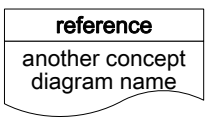
Even though there are many ISO (International Organization for Standardization) standards which contain a section –usually an informative annex– with concept diagrams, they are described with more detail in [2]. However, the concept diagrams included in ISO documents are not the friendly way to know such a specialized science or discipline (e.g., metrology) specially for the novice student. Even though an optional graphic representation has been already explored by ISO through the Unified Modeling Language (UML) [3], the scope of that representation is more oriented towards software development, rather than towards the understanding of the concept system.

OSSAD is a visual language developed initially for the support of office systems analysis and design [4]. However, several adaptations had been made for using it in documenting quality management systems [5], and as a tool for integration of management systems [6]. Its versatility has been proved, and is a friendly scheme for documenting management systems. This project aims to show how using the symbols and grammar rules of OSSAD could make improvements in the level of comprehension of the VIM [7]. It is important to note that the use of OSSAD is not meant to become a replacement for traditional concept diagrams, but is intended to be an alternative or complementary notation.

2. Mapping of terminology elements with OSSAD

OSSAD original methodology uses three levels of representation: an abstract model for systems, a descriptive model for processes, and a prescriptive model for instructions. Even when here the aim is not towards processes mapping, it is possible to apply a kind of "process approach" to the documentation of the several concept diagrams usually included in the terminology or vocabulary of ISO standards. In that sense, the whole vocabulary would be the "conceptual system" and the different concept diagrams included in a specific vocabulary would be the different "processes" which, of course, would be interrelated and interacting as a set aiming to a specific target. The table 1 describes the concepts in [1,2] used in the VIM, along with the corresponding proposed OSSAD modelling elements.

Table 1. Equivalence between the concepts and symbols proposed in [1,2] and their representation in OSSAD visual language.

[1, 2]	OSSAD symbol	Description
concept		A rectangle with the name of the terminological concept. Lines could be single, double, dotted or heavy (see below).
		The first type of generic relation. Heavy arrows pointing towards every specific concept included. As in [7], when one or more specific concepts exist but are not represented, a rectangle with three dots is included.
		The second type of generic relation is represented by an arrow with a tray which contains the dimension criterion. Specific concepts are linked with Boolean "OR" connectors.
		A partitive relation is represented by a macro-rectangle with heavy line which title is the comprehensive concept. Every single partitive concept is represented in a rectangle. Several partitive concepts of a given type are represented by a heavy line rectangle, and if such plurality is uncertain a dotted line rectangle is used. All the concepts in the macro-rectangle are linked with Boolean "AND" (&) connectors.
(concept)		A concept not defined in the VIM is represented by double-line rectangles.
		The associative relation is represented by a double-headed dotted-line arrow.
(see Fig. A#)		A parenthetic reference to another concept diagram is indicated by a document symbol with two compartments used to divide the concept diagram reference and its name.

3. Examples of mapping of VIM concept diagrams with OSSAD

Application of the equivalences defined in table 1 on a couple of concept diagrams of the VIM, figures 1 and 2, has been made. As can be seen, is a more intuitive graphical description of the metrological concepts than the conceptual diagrams on figures A.1 and A.2 in the VIM.

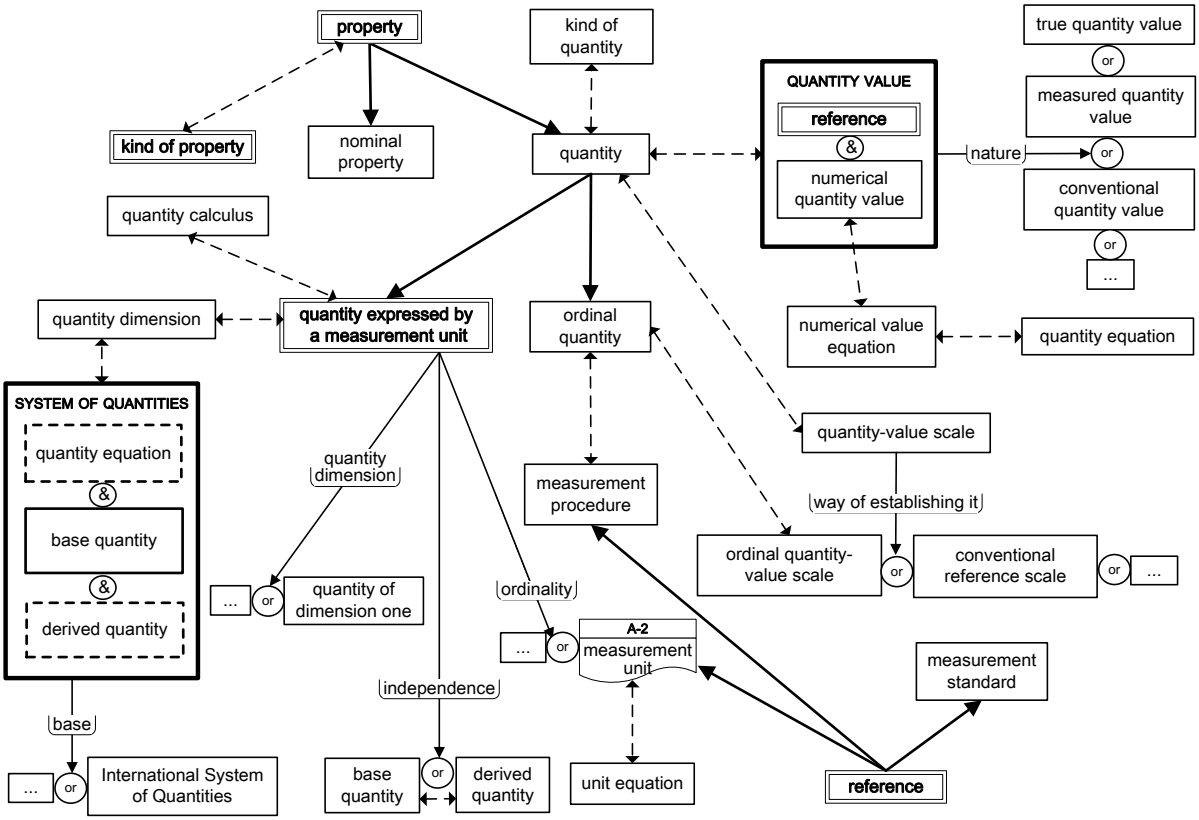


Figure 1. Equivalent OSSAD graphic description of the concept diagram for "quantity" in VIM.

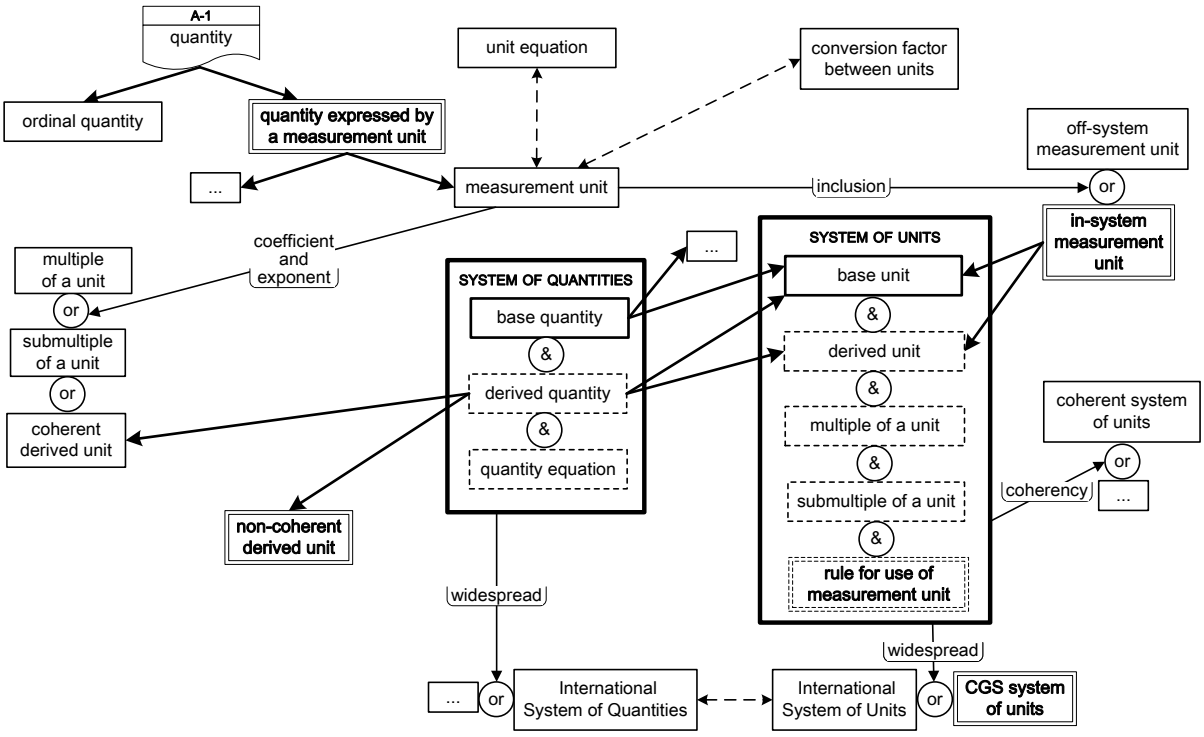


Figure 2. Equivalent OSSAD graphic description of the concept diagram for "measurement unit".

Among the most easily noted differences are: there is no crossing lines on the OSSAD diagrams, the partitive relations stand out notoriously due to the "concept macro-boxes", the document icon makes easy the connection between several diagrams, and the Boolean connectors made easier to understand the relationships between the concepts. However, these apparent advantages need to be tested, to be able to get some conclusions about its understanding for the novice metrologist.

4. Testing OSSAD diagrams vs VIM concept diagrams

A questionnaire (table 2) was developed and applied to under-graduated metrology course students. The students were divided into two groups with eleven students each one. Students in Group A were asked to study the VIM concept diagrams explanation (pp. 65-67 in [7]) for ten minutes, then the "quantity" concept diagram (p. 68 in [7]) was provided, along with another five minutes allowed for its analysis. Finally, the VIM concept diagrams explanation was withdrawn and the questionnaire was given with no time limit to respond it. On the other hand, students in the Group B were asked to study the OSSAD concept diagrams explanation which was based on the second and third columns of table 1, but with a very similar appearance to pp. 65-67 in [7]. After that, the "quantity" OSSAD concept diagram (figure 1) was provided with additional five minutes allowed for its analysis. As with the Group A, the same questionnaire was applied after the OSSAD concept diagrams explanation was withdrawn, no time limit to respond it. In both groups, the questionnaire was anonymous.

Table 2. Questionnaire to test the comprehension level of concept diagram representations.

#	Question or statement	Multiple choice answers
1	What kind of relation exists between the concepts '*ordinal quantity*' and '*measurement procedure*'?	a) partitive b) non-hierarchical c) generic
2	The definitions of the concepts '*reference*' and '*property*' are included in the VIM.	a) true b) false
3	The concepts '*quantity equation*', '*base quantity*' and '*derived quantity*' are _____ the concept '*system of quantities*'.	a) associated concepts to b) partitive concepts of c) specific concepts of
4	The concepts '*ordinal quantity*' and '*quantity expressed by a measurement unit*' are _____ the concept '*quantity*'.	a) associated concepts to b) partitive concepts of c) specific concepts of
5	According to "*quantity*" concept diagram, it is known how many partial concepts of the concept _____ there are.	a) '*quantity equation*' b) '*base quantity*' c) '*derived quantity*'
6	According to "*quantity*" concept diagram, there are several partial concepts of the concept '*numeric quantity value*'.	a) true b) false
7	What kind of relation is there among the concept '*quantity value*' and the concepts '*true quantity value*', '*measured quantity value*', and '*conventional quantity value*'?	a) generic b) partitive c) associative

5. Results and discussion

The results of the quick comprehension questionnaire are showed in table 3. As can be seen, the Group A who worked with the original VIM concept diagrams had the same performance level than the Group B who worked with the proposed OSSAD concept diagrams. However, it is worth to note some remarkable issues:

i. The results of Group A are more balanced, almost all responses retain 5/6 or 4/7 ratios between right / wrong answers. On the other side, Group B has three questions with totally polarized answers, two questions were correctly answered and the other one was incorrectly answered.

ii. Group B reach 100 % comprehension with question #2, and more than 90 % with question #1.

iii. Group B failed with question #4. It will be argued below.

Table 3. Questionnaire results from undergraduate students attending metrology fundamentals course for the first time.

Question number	Group A (VIM concept diagrams)		Group B (OSSAD concept diagrams)	
	Right answers	Wrong answers	Right answers	Wrong answers
1	7	4	10	1
2	8	3	11	0
3	6	5	5	6
4	4	7	1	10
5	7	4	6	5
6	5	6	5	6
7	6	5	7	4
Total	**43**	**34**	**45**	**32**

Answers in Group A balanced around right/wrong could be an indication that the graphical description system of VIM depends a lot on the visual ability of the student, and her capability to work with naked words or phrases and different classes of lines only without other geometrical forms around.

Instead, Group B had almost half of their answers fully loaded to one side or another, and this is a clear indication of what are the strengths and the weaknesses for the OSSAD conceptual diagrams system. Concepts relationship asked in questions #1 and #2 were correctly answered by practically all the students. Question #4 appears to be a weakness, but a possible explanation had been traced to the fact that the Spanish version of figure 1 used in the questionnaire did not show the two arrows in bold that go from the concept 'quantity' to the concepts 'ordinal quantity' and 'quantity expressed by a measurement unit' starting from the same location point, as exemplified in the central column of the fourth row of table 1 (see also figure 3). With respect to the other questions, similar behavior to the VIM concept diagrams was obtained.

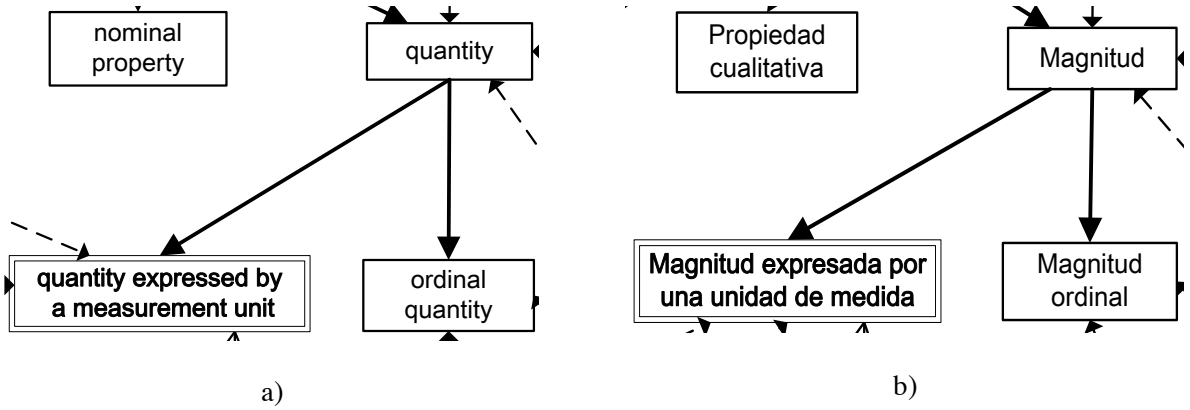


Figure 3. Little but striking difference in generic relation diagram: a) English, b) Spanish.

UML language is another option to visualize the VIM concept system, as showed in [3]. However, as stated in [8] UML is more oriented towards documentation of software-intensive system, including the object-oriented modeling for language programming. Nevertheless, it is another option which could be evaluated together with OSSAD and the current graphical representation of the VIM in a future research.

Finally, it is important to highlight that the scope of the concept diagrams of the VIM is more directed to verification of the systematic concepts definitions than to visual representations, so the visual expressive power of the system employed is weaker than OSSAD, which was born as a visual language and here is proposed an adaptation from its original intention, that is, the workflow process mapping.

6. Conclusions

OSSAD had been applied onto the graphical description of VIM concepts. It has been shown that the terminological concepts defined and used in the VIM can be represented by a limited set of symbols in the OSSAD language. A couple of VIM concept diagrams have been translated to the proposed OSSAD approach, and one of them has been used to test the relative level of understanding of the VIM's concepts relationships between twenty novice students of metrology. According to the results of a questionnaire (in Spanish) applied to them, the proposed representation system has a better visual expressive power. However, it is important to emphasize that the use of OSSAD is not meant to become a replacement for traditional concept diagrams, but is intended to be an alternative and complementary notation.

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