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Evaluating UML Using a Generic Quality Framework

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INTRODUCTION

According to Booch, Rumbaugh, and Jacobson (2005), developing a model for an industrial strength software system before its construction is increasingly regarded as a necessary activity in information systems development. The use of object-oriented modeling in analysis and design started to become popular in the late 80s, producing a large number of different languages and approaches. Over the last 10 years, UML (OMG, 2006a) has taken a leading position in this area.

In this chapter, we give an overview assessment of UML using a generic evaluation framework. We will first present the evaluation framework. We will then evaluate the language quality of UML before pointing to the future direction and potential of UML.

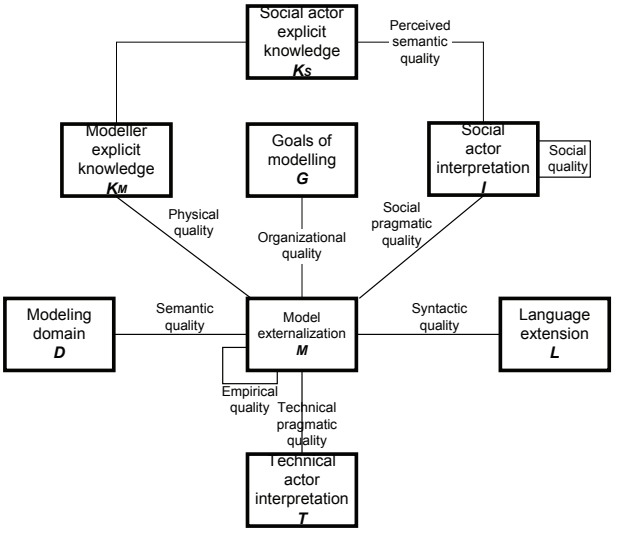
BACKGROUND

Earlier, we developed a framework for understanding and assessing quality of models and modeling languages (Krogstie & Sølvberg, 2003; Krogstie, Sindre, & Jørgensen, 2006).

The main concepts of the framework and their relationships are shown in Figure 1 and are explained next. Quality has been defined referring to the correspondence between statements belonging to the following sets:

- G, the goals of the modeling task
- L, the language extension (i.e., the set of all statements that are possible to make according to the graphemes, vocabulary, and syntax of the modeling languages used)
- D, the domain (i.e., the set of all statements that can be stated about the situation at hand)
- M, the externalized model itself
- Ks, the relevant explicit knowledge of those being involved in modeling. A subset of these is actively involved in modeling, and their explicit knowledge is indicated by K_M.
- I, the social actor interpretation (i.e., the set of all statements that the audience thinks that an externalized model consists of)
- T, the technical actor interpretation (i.e., the statements in the model as "interpreted" by modeling tools)

Figure 1. Framework for discussing the quality of models



The main quality types are indicated by solid lines between the sets and are described briefly next:

- **Physical quality:** The basic quality goals on the physical level is that the knowledge K of the domain D has been externalized, and internalizeability, that the externalized model M is available.
- **Empirical quality** deals with predictable error frequencies when a model is read or written by different users, coding (e.g., shapes of boxes) and HCI-ergonomics for documentation and modeling-tools. For instance, graph layout to avoid crossing lines in a model is a mean to address the empirical quality of a model.
- **Syntactic quality** is the correspondence between the model M and the language extension L.
- **Semantic quality** is the correspondence between the model M and the domain D. This includes validity and completeness.
- **Perceived semantic quality** is the similar correspondence between the audience interpretation I of a model M and his or hers current knowledge K of the domain D.
- **Pragmatic quality** is the correspondence between the model M and the audience's interpretation and application of it (I). We differentiate between social pragmatic quality (to what extent people understand and are able to use the models) and technical pragmatic quality (to what extent tools can be made that interpret the models).

The goal defined for social quality is agreement among audience members' interpretations I.

The organizational quality of the model relates to that all statements in the model contribute to fulfilling the goals of modeling (organizational goal validity), and that all the goals of modeling are addressed through the model (organizational goal completeness).

Language quality relates the modeling language used to the other sets. Six quality areas for language quality are identified with aspects related to both the language metamodel and the notation as illustrated in Figure 2.

- **Domain appropriateness:** This relates the language and the domain. Ideally, the conceptual basis must be powerful enough to express anything in the domain, not having what Wand and Weber (1993) term construct deficit. On the other hand, you should not be able to express things that are not in the domain (i.e., what is termed construct excess) (Wand et al., 1993). Domain appropriateness is primarily a mean to achieve physical quality, and through this, to achieve semantic quality.
- **Participant language knowledge appropriateness** relates the social actors' explicit knowledge to the language. Participant language knowledge appropriateness is primarily a mean to achieve physical and pragmatic quality.
- **Knowledge externalizability appropriateness:** This area relates the language extension to the participant knowledge. The goal is that there are no statements in the explicit knowledge of the modeler that cannot be expressed in the language. Knowledge externalizability appropriateness is primarily a mean to achieve physical quality.

Figure 2. Language quality in the quality framework