

Chapter 14

From Semi-Formal Models to Formal Models¹

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ABSTRACT

- Levels of Knowledge Formalization
- Meta-Modeling—A Transformation Tool between Models
 - Meta-Models
 - Meta-Models and Modeling Spaces
 - Transformation Process between Models
- Method for Transforming Semi-Formal Models into Ontologies
 - Process of Formalization into a Domain Ontology
 - Import into an OWL Modeling Space
 - Disambiguation of a Semi-Formal Model
- Transformation into a Domain Ontology
- Validation Process
- Illustration of Machine-Assisted Ontology Formalization
 - Producing a Semi-Formal Knowledge Model
 - Formalization of the Model
 - Validation of the Resulting Ontology

Ontological engineering is a methodology that proposes various processes for constructing ontologies (Corcho, Fernández-López, & Gómez-Pérez, 2006; Davies, Fensel, & Harmelen, 2003; Dietz, 2006; Gašević, Djurić, & Devedžić, 2006; Gómez-Pérez, Fernández-López, & Corcho, 2003; T. Gruber, 1993; Guarino, 1997; Horridge, Knub-

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lauch, Rector, Stevens, & Wroe, 2004; Uschold & Gruninger, 1996).

Such a process begins with a knowledge elicitation step for the target domain based on the services that the ontology is expected to provide. This step allows for the identification and structuring of the domain’s knowledge through documentation and consultation with experts. The next step involves the formalization of knowledge into an ontology. Ontologies can afterwards be processed by software agents using inference engines to deduce facts that were not provided by constructor of the model. The final step, validation, ensures that the ontology is effective in accounting for all useful knowledge needed to satisfy the original objectives.

The nature of the knowledge to be represented and the diversity of its sources (documents, oral and written communications, graphic representations, tacit knowledge, etc.) can make the process of designing an ontology tedious. In particular, in the scientific literature in education and psychology, declarative, procedural, and strategic (or conditional) knowledge is usually discussed (Paquette, 2002; Paris, Lipson & Wixson, 1983), which adds to the complexity of the process.

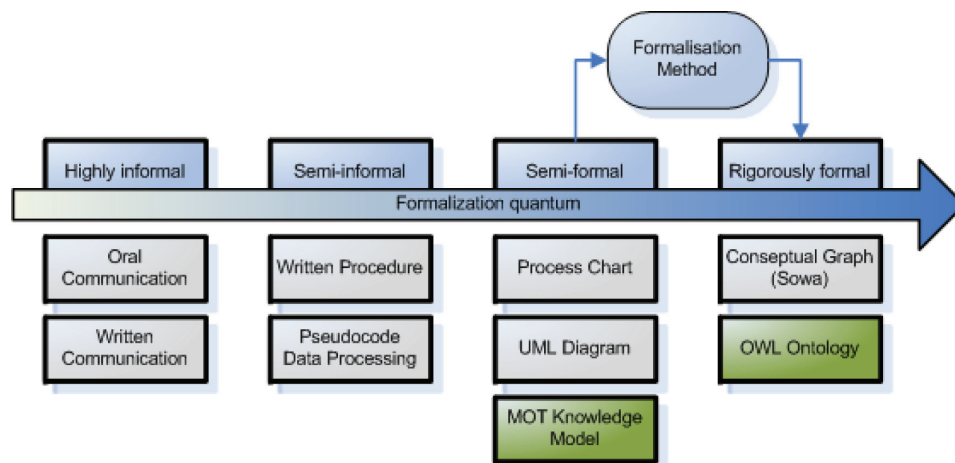
This chapter contributes to the field of ontological engineering by building a methodology that starts by building semi-formal models and subsequently, transforms this type of model into an ontology. The first section describes the concepts of semi-formal models and formal models, and justifies an ontological engineering methodology based on the transformation of semi-formal models. In Section 2, we will explain the role of meta-models in this methodology. In Section 3, we present the ontological engineering methodology, and in Section 4, we present a concrete example of transformation of a semi-formal model into an ontology.

14.1 LEVELS OF KNOWLEDGE FORMALIZATION

Uschold & Gruninger (1996) classify representational languages into four levels, as shown in Figure 1.

- The *highly informal* level involved the use of natural language, which is the most commonly used in human communications. This type of knowledge representa-

Figure 1. Levels of formalization of knowledge representation languages



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