Chapter 5
Representing Classes of Things and Properties in General in Conceptual Modelling: An Empirical Evaluation

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ABSTRACT

How classes of things and properties in general should be represented in conceptual models is a fundamental issue. For example, proponents of object-role modelling argue that no distinction should be made between the two constructs, whereas proponents of entity-relationship modelling argue the distinction is important but provide ambiguous guidelines about how the distinction should be made. In this paper, the authors use ontological theory and cognition theory to provide guidelines about how classification should be represented in conceptual models. The authors experimented to test whether clearly distinguishing between classes of things and properties in general enabled users of conceptual models to better understand a domain. They describe a cognitive processing study that examined whether clearly distinguishing between classes of things and properties in general impacts the cognitive behaviours of the users. The results support the use of ontologically sound representations of classes of things and properties in conceptual modelling.

DOI: 10.4018/978-1-61350-471-0.ch005

1. INTRODUCTION

The notions of classes of things and the properties that things in the class possess (properties in general) have been of interest to philosophers concerned with ontology (the nature of the world) (e.g., Bunge, 1977). They have also been of interest to information systems researchers and practitioners concerned with finding better ways to model the world. For instance, the representation of classes of things and properties in general features in early work on conceptual modelling (Chen, 1976; Nijssen, 1976; Kent, 1978). It also features in more-recent object-oriented conceptual modelling approaches–in particular, the Unified Modelling Language (e.g., Rumbaugh et al., 1999).

For a number of reasons, the notions of classes of things and properties in general and their representation in conceptual models are problematic. First, not all scholars agree that things and properties are distinct phenomena. For instance, nominalist philosophers "dispense with properties, which they regard as Platonic fictions, and attempt to reduce everything to things, their names, and collections of such" (Bunge, 1977, p. 57). Moreover, those philosophers who do sustain a distinction between things and properties face the difficult task of showing how the distinction should be made (e.g., Denkel, 1996).

Second, some information systems scholars argue the distinction between classes of things and properties in general ought not to be sustained in conceptual models, because different users may perceive the same phenomena differently (in short, implicitly these scholars subscribe to a nominalist philosophy). For example, in the object-role approach to conceptual modelling, the distinction between classes of things and properties in general is not maintained (Halpin, 2008). Both are represented using the object symbol in a conceptual model. Similarly, Date (2003, p. 436) eschews the distinction between an entity (thing) and a relationship (type of property of a thing): "In this writer's opinion, any approach that insists on making such a distinction is seriously flawed, because…*the very same object* can quite legitimately be regarded as an entity by some users and a relationship by others."

Third, even when conceptual modelling approaches allow classes of things to be distinguished from properties in general, how the distinction should be maintained is often unclear. In the entity-relationship (ER) model (Chen, 1976), for example, classes of things are supposed to be represented as entity types, and properties in general are supposed to be represented as attribute types. Nonetheless, entity-type symbols are often used to represent both classes of things and properties in general. For instance, a *preference*, which many individuals would deem to be a property in general of a class of things, might be represented as an entity type that is connected via a relationship type to a *client* entity type (see, e.g., Connolly & Begg, 2005, p. 344).

Fourth, disputes arise about how classes of things and properties in general should be represented in conceptual models if database design considerations are to be taken into account. For example, Simsion and Witt (2001, p. 104) state: "Attributes in an ER model correspond to columns in a relational model." They further suggest that ER models should be "normalized" and repeating groups of attributes removed to form additional entity types. Thus, they argue that representations in a conceptual model ought to be influenced by database design considerations.

A conceptual model is used to discover and document user views of an information system and to provide a basis for informed discernment, reconciliation, and compromise among users and information systems professionals (Hirschheim et al., 1995). Therefore, we argue that the representation of classes of things and properties in general in conceptual models should be based on a sound underlying theory about the structure and dynamics of phenomena in the world (Parsons & Wand, 2008). In this regard, however, little empirical work has been done (Evermann & Wand,