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Combined Use of Conceptual Models in Practice:
An Exploratory Study

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ABSTRACT

Conceptual models are fundamental to system analysis and design. However, the actual usage of conceptual models remains poorly understood, in particular, how and why practitioners would use multiple models in combination when doing their work. In this paper, the authors explore the reported use of multiple conceptual models for system analysis and design to determine the circumstances that lead professionals to use multiple models. They uncover both semantic and pragmatic reasons that influence the choice and selection of different models for system analysis and design tasks. Contrasting these findings to existing ontological theories, the authors find that the extent and type of multiple model use is determined by not only ontological factors but also contextual factors that can override ontological qualities and in so doing bring forth desired qualities for users. The authors offer several novel propositions about the implications of ontological theory that will be worth exploring in future research.

KEYWORDS

Combined Use, Completeness, Conceptual Models, Context, Ontological Analysis, Ontology, Qualitative Research, Representation Theory, Semi-Structured Interviews

1. INTRODUCTION

System designers and analysts often begin their work by developing and using graphical representations of relevant features of the domain under examination (Burton-Jones and Meso, 2006). These representations are called conceptual models (Wand and Weber, 2002). They play a significant role in the early detection and correction of systems development errors and help analysts to better communicate with stakeholders (Moody, 2005; Saghafi and Wand, 2014).

Much research on conceptual models and the grammars with which they are created has been conducted over the past decades, often using ontological analysis (Wand and Weber, 1990, 1993, 1995). Ontological analysis allows researchers to suggest how grammars for conceptual modeling might be modified to be ontologically sound and how well developed models that correspond to

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ontological guidelines are understood. There is a strong track record of studies showing empirical support for these guidelines (Saghafi and Wand, 2014). Yet noticeably, this rich research tradition has focused almost entirely on the evaluation of single grammars (like UML, ERD, BPMN and so forth) or single models (such as those that are ontologically clear versus unclear).

One important insight from this stream of research is that no single available grammar is ontologically complete (e.g., Irwin and Turk, 2005; Opdahl and Henderson-Sellers, 2002; Recker, Rosemann, Indulska, and Green, 2009; Wand and Weber, 1993; Weber, 1996). This situation implies that users will never be able to create a single model that fully represents all relevant aspects of the real-world phenomena they wish to have represented.

This situation is not necessarily problematic; in fact, incompleteness seems to be a design choice for many popular grammars: UML, for example, provides fourteen different grammars to describe structure, behavior, and interactions of a system from a variety of perspectives, each of which is, by necessity, incomplete (Rumbaugh, Jacobson, and Booch, 2004). Other longstanding methodologies, such as Multiview (Avison and Wood-Harper, 1986), have promoted the use of multiple models with different perspectives for close to thirty years.

In this paper, we explore two questions that follow from this situation: how do analysts and designers deal with the fact that any model they have available is not a complete representation? How do they select from a variety of possibly available models given that each of them will offer some representation but never a complete one? The proposition that we put forward is that they use multiple models in combination such that the completeness of the representation of their relevant real-world phenomena can be maximized.

We are not the first to make this proposition. Theoretically, this proposition has been explored, firstly, by Weber (1997) and Green (1996) who suggested two principles, maximum ontological completeness and minimal ontological overlap, to explain why designers might select different grammars for conceptual modeling. More recently, Recker (2014) suggested theoretical arguments in a theory of faithful use of conceptual model combinations. Yet, what remains notably absent is *empirical knowledge* about how practitioners work with multiple models. We take this step in this paper and explore two broad research questions:

RQ1: Why are systems analysts and designers using multiple conceptual models?
RQ2: How are systems analysts and designers using multiple conceptual models?

Our contribution is primarily empirical: we set out to explore current practices in the actual use of multiple conceptual models, which is surprisingly scarce in the literature. In doing so, we also provide theoretical contributions: through our work, we identify a range of contextual and contingency variables that impact on the use of conceptual models; and we will show how these variables extend upon the understanding that can be generated through ontological analysis alone and in turn how ontological theory might be improved.

We proceed as follows: First, we review prior ontological analysis and empirical studies on conceptual modeling. Then we discuss the research method and how we designed our research. Section 4 reports the results in two parts in line with our research questions. In section 5, we summarize the main contributions, outline implications for the research and practice, and review potential limitations of the work. We close in section 6 by drawing some conclusions from our work.