

On Ontological Foundations of Conceptual Modeling: A Response to Wyssusek

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1 Introduction

We welcome this opportunity to respond to Wyssusek's (2006) critique of our work on the ontological foundations of conceptual modeling and, more generally, the ontological foundations of information systems. We appreciate his interest in and his undertaking a careful analysis of our work. We hope, in turn, that our responses will sharpen our discourse—to pinpoint more clearly where we agree and where we disagree.

In the sections below, we first indicate briefly where we agree for the most part with Wyssusek's arguments. We then address in more depth those areas where we are at odds with his views. Our goal is to debunk his arguments about how our work is flawed. Next, we address two matters that we see as incidental to Wyssusek's and our respective positions. Nonetheless, these matters seem important to him in terms of his criticisms of our work. Finally, we provide some brief conclusions.

2 Matters of Agreement (For the Most Part)

In the first section of his paper, Wyssusek provides a brief explanation of the importance of and history of conceptual modeling. In particular, he focuses on the “yet another modeling approach” (YAMA) and “not another modeling approach” (NAMA) syndromes that motivated our own work to find theoretical foundations for information systems. For the most part, we concur with his account. He argues, however, that “[s]o far, claims made for the validity of the BWW ontology¹ have not been subjected to critical evaluation.” We disagree. We have undertaken empirical tests of the “validity” of predictions based on the ontology (e.g., Bodart et al. 2001; Gemino and Wand 2005), and other colleagues have undertaken similar “validation” tests (e.g., Parsons and Cole 2004, Burton-Jones and Meso 2006). Perhaps Wyssusek has a particular notion of validity that we fail to understand. Perhaps he also has a particular notion of “critical evaluation” that we fail to understand. For our part, we have followed a time-honored tradition in science—namely, that the validity of theories needs to be tested empirically.

In the second section of his paper, Wyssusek begins with a discussion on “the roots of conceptual modeling” in artificial intelligence, systems development, database development, programming languages, and human-computer interaction. He provides a compelling account of why conceptual modeling was eventually recognized as important in all these domains. We applaud and concur with his arguments.

In the latter part of the second section of his paper, however, Wyssusek comments: “Even if critics rarely explain why they believe a theoretical foundation would improve the practice of conceptual modeling, or, what they mean by ‘theoretical foundations of conceptual modeling’, it appears that most critics implicitly or explicitly question the justification for the semantics of the elements of the respective conceptual modeling language (a.k.a. “modeling grammar”).” In our view, “critics” have been especially clear on why they believe having a theory of conceptual modeling would improve the practice of conceptual modeling. In the absence of theory, it is difficult to provide compelling predictions or explanations about conceptual modeling phenomena (e.g., the strengths and weaknesses of a particular conceptual modeling grammar). Moreover, good theory is eminently practical (Van de Ven 1989).

Contrary to Wyssusek’s contention, we also believe that many (if not all) “critics” have explained what they mean by the “theoretical foundations of conceptual modeling.” Indeed, the matter is straightforward. Theory seeks to account for some type of phenomena. The theoretical foundations of concep-

tual modeling seek to account for different types of conceptual modeling phenomena (Wand and Weber 2002).

In the third section of his paper, Wyssusek provides an overview of Bunge's ontology. Wyssusek ascribes several fairly extreme positions to Bunge – for instance, that deviations from realism and objectivism “can only be explained out of a person's mental insanity.” Whether these are a fair representation of Bunge's positions, either in the past or currently, are best left for Bunge himself to determine. Our understanding is that Bunge refers only to “[t]he failure to distinguish the thing represented from its model” (Bunge 1977, p. 121). We believe that few will argue that confusing an actual phenomenon and its mental conception is desirable. We note also that Bunge has worked extensively on the philosophy of the social sciences. He has a deep understanding of the difficult issues surrounding social science topics like realism, objectivism, and relativism.

3 Matters of Disagreement

The heart of Wyssusek's disagreement with our work lies in the fourth section of his paper, where he describes our adoption, adaptation, and use of Bunge's ontological theory. In the latter part of this section, he articulates four specific issues that concern him. We address each below:

3.1 Our failure to adopt dialectical materialism

Wyssusek argues that our “adaptation of Bunge's ontology lacks the ontological commitment that makes Bunge's ontology what it is: a dialectical materialist, hence a realist ontology.” He further argues that our failure to adopt this ontological commitment makes any reference we make to Bunge's ontology “void.”

We are not trained philosophers, and thus we feel ill qualified to enter a lofty debate about what constitutes “dialectical materialism” and the merits of this philosophical stance. Rather, our reasons for adopting Bunge's ontology are more mundane.

Like Bunge, we are realists (at least when we act as scientists). We believe that a world of matter exists independently of humans as observers. Furthermore, we believe this world obeys *laws* of various kinds. Like many other scientists, however, we see no way to establish “true” knowledge of the material world. Instead, as scientists we are part of a community of individuals who seek to build concepts and theories that enhance our understanding of the

material world. We accept the ephemeral nature of these concepts and theories. Indeed, an important goal of science is to articulate new concepts and theories and to refine existing concepts and theories which, according to some type of criteria, enhance our understanding of the world.

As Wysusek points out, Bunge also recognizes the conundrum he faces as a realist—for instance, that the existence of one thing cannot be established without first assuming the existence of another thing (e.g., a human). Moreover, as Wysusek further points out, Bunge in his ontology speaks about “model things.” For instance, for Bunge, properties of things are real because they exist independently of the observer, but as humans we can only know properties via our models of them, which he calls *attributes*. As models of properties, attributes reflect our purposes in modeling some domain, and/or they reflect our best understanding and knowledge of the domain.

Bunge also recognizes that the ongoing task for scientific realists is to find what constitutes reality. Thus he says (Bunge 1979, p. 149): “Science attempts to account for the reality behind appearance, so it either does not employ phenomenal predicates or, if it does, regards them as derived not basic. Surely phenomena, in particular mental phenomena, are experientially immediate, but they are neither ontologically nor scientifically primary: they are something to be explained.”

Like Bunge, our “commitment” is to model the world as best we can. More specifically, in conceptual modeling, our commitment is to model someone else’s model of the world as best we can. BUNGE is also committed to establishing whether scientific models of the world reflect reality or just appearances. We too share this commitment in our work on conceptual modeling. In this regard, we might use our knowledge of conceptual modeling (and ontology) to assist individuals to better understand and model their world. Ultimately, however, it is *their* model. As information systems practitioners, our role is to find the best way we can to represent their model of their world. Just as the constructs in Bunge’s ontology can be used to model “appearances,” they can be used also to model individuals’ models of their worlds. In other words, we believe Bunge’s concepts are applicable not only to describing an objective “true” reality but also to modeling *beliefs* about what exists and what might occur in a given domain of the world.

We can summarize our approach in the form of two assumptions. First, given that the purpose of conceptual modeling is to represent domains of the world, the modeling constructs used should be matched to beliefs about the domain. Second, Bunge’s constructs are an appropriate set for this purpose. Our experience (and the experience of some of our colleagues and students) is that Bunge’s constructs provide us with useful insights about how to better represent individuals’ models. Furthermore, our work and the work of others

have provided us with empirical evidence that predictions based on our two assumptions indeed hold.

3.2 Bunge's terminology and formalisms only accidental to ontology

Wyssusek objects to our using Bunge's formalisms without first having made an "ontological commitment." He comments: "without ontological commitment, the borrowing of constructs, formalisms, and terminology boils down to using Bunge's ontology as a language." If we understand Wyssusek's arguments correctly, this point is an elucidation of his first criticism above.

Clearly, in our use of Bunge's work, we have ascribed *meaning* to the terminology and formalisms that he has used. This meaning is based on Bunge's explanations of the meaning of his terminology and formalisms, our interpretation of his explanations, and our knowledge and experience of the world. We are not generating sentences (language) that might comply with the formal rules of Bunge's "grammar" but have no meaning for us.

Bunge's position is manifested in the assumptions he has made in his ontology, such as (a) the world is made of (substantial) things, and (b) these things possess properties. Even if we assume that adopting these assumptions amounts to subscribing to a "dialectical materialistic" view of the world (or any other ontological "position"), in our opinion we are simply "name calling" (an action that has no bearing on the usefulness of the assumptions). What we declare about our ontological position is not what matters. Rather, what is important is the adoption of a set of ontological constructs that defines and manifests our ontological position. Moreover, even if we were to "admit" we are avid "dialectical materialists," such an admission would have no consequences for the validity or usefulness of our approach.

Prior to our encountering Bunge's ontology, each of us had over 15 years of experience as a practitioner, student, teacher, and researcher in the information systems field. We had encountered many concepts that were used extensively in the information systems and computer science domains—for instance, entity, attribute, system, subsystem, coupling, event, and process. Our frustration was that for the most part these critical concepts were not defined precisely, nor were they used consistently. In Bunge's ontology, we found a comprehensive, precise, and consistent account of many of these concepts. We did not have to make any formal "ontological commitment" to his work. His ontology simply made sense to us, so we used it. When we now converse about concepts like objects, or methods, or systems, or classes, we have a

shared understanding. Thus, by adopting Bunge's concepts, we have acquired a socially constructed reality that has utility for us.

3.3 Bunge's ontology not concerned with how humans structure their conceptions of the world

Wyssusek argues that Bunge deems concepts to be "fictions" and not "concrete objects." They "belong to" the domains of psychology, epistemology, and methodology and not the domain of ontology. Thus, he claims our use of Bunge's work in the domain of conceptual modeling is misguided.

Earlier in his paper, Wyssusek has the following quote from Bunge (1977, p. 119): "Theoretical science and ontology handle not concrete things but concepts of such, in particular conceptual schemata sometime called *model things*." In short, according to this quote from Bunge, ontology does "handle" concepts in the form of conceptual schemata and model things. Bunge understands fully that the only way we can talk about the real world (or concrete things) is via *concepts*. We have no way of knowing about the real world except via our concepts. His two-volume work on ontology is a comprehensive, rigorous articulation of *concepts* that sentient beings might use to conceive the real world (e.g., via attribute predicates and functional schemata). His ontology does not obviate the need to declare what is "out there" in the world. For this reason, Bunge makes assumptions about the nature of and existence of things, properties, compositions, systems, etc.

Similarly, conceptual modeling deals with concepts that we can use to describe the world. To assess whether these concepts are useful, we need to compare them with what we believe exists in the modelled domains and how we conceive of these beliefs. Thus, contrary to Wyssusek's arguments, we see no conflict between Bunge's views on ontology and our use of his ontology in conceptual modeling.

3.4 Ignorance of the larger part of Bunge's ontology and the most relevant parts for conceptual modeling

In our work on the theoretical foundations of conceptual modeling, Wyssusek argues that we have ignored the larger part and most relevant parts of Bunge's work—in particular, Bunge's work on semantics. It seems Wyssusek has reached the view that we are ignorant of Bunge's work because he does not

like the ways we have adapted and used Bunge's work. Of course, he is entitled to his views, and we respect his views.

As best we are able to understand Wyssusek's position, he seems to be arguing that (a) the ontological constructs proposed by Bunge have no meaning because they are formalisms, or (b) any meaning ascribed to the constructs that is not Bunge's meaning renders them invalid. In response, we quote Bunge (1974, p. 56): "Finally, a warning: We are not claiming that a construct is meaningless if it belongs to a theory, but only (i) that a construct has no *clear cut* meaning but in the midst of a theory, (ii) that a construct may *change* its meaning (i.e., it may become a different construct) if transplanted to a different theory, and (iii) that a *theoretical* construct exists only in a theory."

Moreover, Bunge claims (1974, p. 194): Semantics "of factual science [...] has the following presuppositions of a metaphysical character: (i) there are both constructs (in particular concepts) and physical objects (in particular signs); (ii) some signs designate constructs and refer to physical objects; (iii) the theories referring to physical objects constitute more or less adequate (true) representations of aspects of the world." Thus, Bunge links concepts, signs, and physical phenomena.

Bunge's constructs belong to a theory – his theory of ontology (see, especially, Bunge 1977, pp. 10–12). They have a meaning in the context of this theory. As per his comments above, however, he recognizes that a construct *may* change its meaning if transplanted in another theory. Surely, refinement of existing theories, adaptation of existing theories, and development of new theories is the stuff of science. Are we to proscribe such activities?

4 Two Other Matters

In the first part of the fourth section of his paper, Wyssusek provides a brief history of our adaptation of Bunge's work. For the most part, he is correct in his recount of the history. Moreover, we do not wish to quibble about matters of detail.

In his endnote 1, however, Wyssusek seems to take umbrage with our having relied on advice from our colleague, Mattessich, to attend to Bunge's work rather than our having performed a comprehensive search of alternative ontologies.

The fact that an eminent colleague referred us to Bunge's work might or might not be of interest to somebody (although it was fortunate for us). Not only have we never concealed this fact, but we have been happy to mention it at every appropriate opportunity. In any event, the way that scientists become

aware of theories, techniques, or facts has little bearing on the validity or quality of their work. It is a common practice to consult colleagues who possess knowledge a researcher does not have. Indeed, obtaining advice from colleagues by informal, “personal communications” is a common practice in the conduct of science. Examples are the historical accounts of the development of General Relativity (Pais 1982) and the discovery of DNA (Watson 1968). This kind of communication is part of the venerable tradition of creating cumulative knowledge.

In his endnote 2, Wyssusek argues that we have not provided convincing examples of ontological questions that early researchers in conceptual modeling had been addressing prior to work on ontology gaining currency in the information systems and computer science disciplines. Our response to this criticism is straightforward. Early conceptual modeling researchers had been striving to find better ways to model the world. How we describe the world is surely a fundamental ontological question.

5 Conclusions

We conclude with a brief summary of our position and a reflection. In a nutshell, our position is the following:

- Ontological beliefs exist in every human communication, independent of whether they are created by language exchange, are based on observations, or just reflect inter-subjective reality agreed via some social discourse.
- In this light, every conceptual modeling grammar must be related, explicitly or implicitly, to an underlying ontology. Otherwise, it carries no meaning.
- Based on our immediately preceding point, we have proposed a way to evaluate the effectiveness of a conceptual modeling grammar, which is based on a mapping to/from an ontology.
- Whether one states one’s “ontological commitment” explicitly or not, the fact that meaningful communication requires a shared ontology implies such a commitment. This is true both for informal communications and the more formal conduct of science.
- Choosing a specific set of ontological concepts, their relationships, and premises underlying their application is a *de facto* ontological commitment. Whether the belief in such set can be ascribed to one school of thought (such as “dialectical materialism”) or another has no effect on the outcome of adopting an ontological system. What matters is the set

of beliefs about what exists and might happen in the world. Of course, this set of beliefs has to be stated clearly.

- The way a specific set of such constructs is determined (by direct observation, via social interaction, or otherwise) has no bearing on the effectiveness of their use. In other words, epistemological considerations, while indicating how one might arrive at a certain set of ontological beliefs, do not indicate whether the set is appropriate.
- Whether a person is realist, constructivist, or relativist does not obviate the need to use a set of constructs to describe the beliefs the person holds about the world. Even relativists must use concepts to describe their beliefs. Thus, irrespective of the source of one's beliefs, they will be manifested (implicitly or explicitly) by a set of assumptions of what exists and what might happen in the world.
- On a broader note, if we view information systems as representations, then ontological concepts in general can inform our thinking about information systems and information systems analysis and design.
- The question of "which" ontology to use is an open one. Unless it is pre-determined by agreement within a relevant community, we need to "guess" the appropriate ontology.
- In the absence of compelling evidence in favour of a specific ontology, the final verdict about the validity of any ontology-based conclusions must be based on empirical methods and outcomes.
- The fact that we must first choose an ontology does not invalidate the approach of using ontological concepts and premises to analyse conceptual modeling grammars specifically and information systems concepts in general.
- Even if we find a specific set of ontological beliefs provides conclusions that are not corroborated by empirical methods, this outcome would not invalidate the general idea of evaluating a modeling grammar by using a "benchmark" ontology.
- We welcome any other suggestions about "competing" ontologies that we might use. We would be delighted if someone suggests a specific set of ontological beliefs that provides a better foundation for conceptual modeling than the one we have used.

Over the years we have used Bunge's ontology, we have corresponded with him occasionally about our work. As a result of our early work, we were invited to contribute to a major volume on Bunge's "Treatise on Basic Philosophy" (Wand and Weber 1990). In his response to our contribution, Bunge (1990, p. 595) comments: "I welcome the use that Wand and Weber [...] have made of some of the ideas in my ontology to tackle problems in the founda-

tions and philosophy of technology, particularly management science. I take it as an admission of the fruitfulness of the systemic and realistic approach to the study of systems of all kinds.”

Finally, as scientists we are always mindful of an old adage: “the proof of the pudding is in the eating.” Whether our use, adaptation, and extension of Bunge’s ontology have merit depends on the insights they provide about the domains of conceptual modeling and information systems. This outcome we can try to influence but cannot control. Rather, our colleagues and students will be the final arbiters. They will adopt or discard our ideas depending on how well these ideas contribute to their own understandings of the worlds with which they choose to engage.

Notes

1. While we understand that it might be useful to employ the acronym “BWW” to describe our use of and adaptation of Bunge’s (1977; 1979) ontology, we wish to be clear that the fundamental intellectual contributions are those made by Bunge and not us.

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