Response to Wyssusek's "On Ontological Foundations of Conceptual Modelling"

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Several current developments indicate that IS and enterprise models and ontologies will become increasingly important in the years to come, including the OMG's model-driven architecture (MDA) initiative (www.omg.org/mda), the semantic web initiative (Berners-Lee et al. 2001) and increasingly model-driven enterprise systems. Given its long tradition of modelling research, the IS field should play a central role in this development. Yet the IS field has produced few broad theories that can guide the direction of modelling research, assist in interpreting findings and serve as a core for knowledge to accumulate around. A few frameworks for language and model evaluation are much used, including the SEQUAL framework (e.g., Krogstie 2002), based on the work of Lindland, Sindre and Sølvberg (1994). But evaluation is only a part of the modelling picture, and few broader theories are available. The FRISCO framework was an early theory proposal (Falkenberg et al. 1998), but it is unfortunately used too little today.

1 The BWW Model

Some researchers use philosophical ontology as a theory for modelling research. Many of them base their work on Wand and Weber's (e.g., 1988; 1990; 1993; 1995) adaptation of Mario Bunge's ontology (1977; 1979) to the IS field.[1] There is already a body of existing work based on the BWW model and Bunge's ontology. This body addresses a variety of fields related to IS,

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including conceptual modelling and related types of modelling, data quality, databases, enterprise system alignment, IS interoperability, meta modelling, method engineering, object-oriented analysis, parts and wholes, reference modelling, requirements engineering for standard systems and self-adaptive software systems. For references, see, e.g., Wand and Weber (2002), Opdahl and Henderson-Sellers (2002) and Rosemann and Wyssusek (2005).

The body of existing work indicates that the BWW model and Bunge's ontology are potentially useful for IS and enterprise modelling research in several ways. (1) They offer a well-developed theoretical position that is both native to IS, through Wand and Weber's adaptation, and continuous with established positions in the natural and social sciences, as demonstrated by Bunge (1977; 1979). (2) They offer a viewpoint that is an alternative to the mathematically formal perspective that dominates parts of IS and software modelling today. Although mathematical formality can be a useful property of models and modelling languages for certain purposes, it aids little in establishing what the resulting models are about. (3) They offer a viewpoint that is an alternative to the software-oriented and, in particular, object-oriented perspective that dominate other parts of IS modelling.[2] For example, UML 2.0 (www.uml.org) presents diagram types that are clearly intended to represent human organisations, IS users and their problem domains, but that are often defined purely in software terms.[3] The BWW model and Bunge's ontology are potentially useful for IS in other ways too, but the usefulness and productiveness of the BWW model is not the focus of this brief response.

2 Critical Reviews

The body of existing work that uses the BWW model and Bunge's ontology includes several critiques of and proposals for revising and extending the BWW model. For example, Green and Rosemann (2000) question the robustness of certain BWW-concepts. Rosemann and Green (2002) represent the BWW model alternatively as a meta-model using the extended entity-relationship (EER) model. Parsons and Cole (2004) experimentally examine the relevance of an additional Bunge-concept, that of property precedence, for conceptual modelling. Opdahl and Henderson-Sellers (2004; 2005) propose a structured approach and a corresponding meta-meta model for using the BWW model to describe modelling constructs. Green and Rosemann (2005b) propose a more stringent method for using the BWW model to analyse and evaluate modelling languages. Rosemann and Wyssusek (2005) propose to

extend the BWW model with additional systemic concepts taken from Bunge's (1999) Ontology II.

The body of existing work using the BWW model and Bunge's ontology also sometimes uses them in combination with alternative frameworks, theories or ontologies. For example, Parsons and Wand (1997) use both the BWW model and classification theory to better understand OO modelling concepts. Bodart et al. (2001) use the BWW model in combination with semantic-network theory from cognitive psychology (see, e.g., Anderson 1990) in their experimental evaluation of optional properties in conceptual modelling. Opdahl et al. (2000) use the BWW model alongside FRISCO (Falkenberg et al. 1996) to analyse the OPEN Modelling Language (Firesmith et al. 1997). Workshops and publications where the BWW model plays a central role (e.g., Dampney 1999; Green and Rosemann 2005a) also make room for papers based on or proposing other foundations, including Guizzardi and Wagner's (2005) unified foundational ontology, Milton and Kazmierczak's (1999; 2005) use of Chisholm's (1996) common-sense ontology and Shanks' (1999) use of semiotics.[4]

Many of the researchers who base their work on the BWW model and Bunge's ontology will subscribe to the (sound) principle of always making the strongest possible theoretical claims in order to encourage theory falsification and thus foster theory development. And, like all researchers, they will defend their theoretical core assumptions within limits. But the body of existing work shows that researchers who base their work on the BWW model and Bunge's ontology do not view it is as an ultimate or unquestionable theory. Nor do they have an inherently imperialist attitude towards alternative theories. And they constitute an open and inclusive community. Indeed, Bunge foresaw this situation in the introduction to his ontology: "The result is a system but not a closed and final one: there is much room for improvement and of course also for divergent developments" (Bunge 1977, p. xiv).

In this light, Wyssusek's statement that "claims made for the validity of the BWW ontology have not been subjected to critical evaluation" (Wyssusek 2006, p. 64) is unjustified. Indeed, the body of existing work shows that the BWW model has been continuously evaluated, compared and refined since it was first proposed through a battery of research methods that includes evaluations, experiments, surveys and design research. The focus on practical IS problems as opposed to philosophy-level discussions is explained by Weber (1997) when he argues that ontological models for conceptual modelling should primarily be evaluated according to how well they inform conceptual modelling practice and research.

For my part, this is not to downplay the importance of clarifying the philosophical and other foundations of the IS field. This can be both illuminating

and inspiring for practice and research. But a community of mostly non-philosophers run into danger when they try to deal with controversy at an almost purely philosophical level. Discussions can too quickly degenerate into the "My philosopher is better than your philosopher" variety or into meta-disciplinary discussions of the "My reference discipline is better than your reference discipline" kind. Most IS researchers are not schooled to contribute to or arbitrate in such discussions, in particular when the very long traditions of parts of philosophy, like ontology, are taken into account. Philosophy-level discussions among IS researchers should therefore be carefully tied to IS practice and research, and be arbitrated as much as possible at the IS level, in order to ensure that they remain sound and relevant.

3 Conceptualisations and Social Constructions

In his Ontology I, Bunge (1977, p. 119) makes it clear that "Theoretical science and ontology handle not concrete things but concepts of such, in particular conceptual schemata sometimes called model things". A scientific ontology such as Bunge's is therefore a conceptual system, although it is a conceptual system that stands out because it is based on the sciences. Furthermore, it is based on scientific theories that are to an extent constructed socially by scientific communities, although they are social constructions that stand out because they are established through scientific method. Hence, whereas a scientific ontology is about concrete things that exist independently of human observers, at the same time the ontology is a conceptual system that is based to an extent on social constructions. Weber (1997) is therefore justified when he says about conceptual-modelling researchers that "Like the ontological researchers in philosophy, they, too, were concerned with how humans structure their conceptions of the world" (Weber 1997, p. 73).

It is essential to make this fine distinction between what a scientific ontology is (a conceptual system that is based on social constructions, albeit in a very restricted sense) and what scientific ontology is about (concrete things that exist independently of human observers). Rosemann and Wyssusek (2005, p. 2803) write that "some of the ontological approaches are based on the understanding of ontology as 'a specification of some conceptualization' […], other approaches are based on an understanding in philosophical terms". They consider the BWW model an example of the latter. But the two understandings of ontology are not necessarily in conflict. From the same view-

point, it is also unclear what Wyssusek (2006, p. 70) means when he claims that

> "Wand and Weber have been interested in the quality of the mapping between information system user's conceptualizations of the real world and the representations of these conceptualizations in the information system. They have not been interested in the quality of the mapping between the 'real world' and the user's conceptualizations of the 'real world'".

But how can anyone map between the "real world" and users' conceptualizations of the "real world" when the former is only available to us as a conceptualisation?[5]

Conceptualisations and social constructions are important because many—some argue all—of the phenomena we encounter in IS practice and research are conceptually and/or socially constructed. In a related paper, Rosemann and Wyssusek (2005, p. 2804) misquote Brian Henderson-Sellers and me when they claim that "Opdahl and Henderson-Sellers (2004) recognized that the BWW ontology seems to be well-suited for the modeling of concrete things such as materials, but not for the modeling of, e.g., social constructs." What Opdahl and Henderson-Sellers (2004, p. 70) stated was that "this paper focuses on modeling constructs that represent concrete problem domains, i.e., that represent materials rather than concepts. Further work should [extend our proposal] to account for modeling constructs that represent social constructs and mental concepts". This is far from saying that the BWW model is not well suited for modelling social constructs. To the contrary, when we point to social constructs and mental concepts as further work, it suggests that we consider them compatible with the BWW model indeed.

4 Ontological Commitment

Wyssusek (2006) also claims that the BWW model is a formal model, apparently based on Bunge's distinction between formal models that do not refer to any factual object (Bunge 1974a, p. 39) and factual models that refer to at least one such object (or concrete thing). I cannot see how the BWW model can be understood as never referring to factual objects or concrete things. As I understand it, when Wand and Weber chose to adapt an ontology committed to scientific ontology, they also chose to subscribe to the underlying ontological commitment. I see this as an obvious point that one should not have to state. A table such as Table 1 in (Wand and Weber 1993) recurs in many BWW-based papers. This table lists the most important BWW-concepts and defines them in ways that point directly to Bunge's original ontological commitment. And the

many papers that use the BWW model to analyse and evaluate IS and enterprise modelling constructs, such as the ERM analysis in (Wand and Weber 1995), can also only be understood in the context of that ontological commitment. This is certainly how I have understood the BWW model since I first read about it almost twenty years ago, and this is how I have used the BWW model for almost a decade.

Wyssusek (2006) backs up his claim by stating that "Wand and Weber's justification of their adaptation of Bunge's ontology lacks the ontological commitment that makes Bunge's ontology what it is". But Wand and Weber (1993, pp. 220–221) explain that they chose Bunge's ontology because "he is concerned with concepts that are fundamental to the computer science and information system domains". In other words, the referents (in the "real world") of Bunge's ontological concepts are considered fundamental to clarifying concepts (also referring to the "real world", although to a smaller part of it) that are used in computer science and information systems. It is hard to see how this is not a subscription to Bunge's ontological commitment, perhaps unless one does not make the fine distinction between what scientific ontology is and what it is about, as already discussed.[6]

When they developed their model, Wand and Weber lifted out and adapted a selection of Bunge's ontological concepts to the IS field while retaining, I have assumed, the reference of those concepts. In the process they also offered a mathematical formalisation considered more appropriate to the IS field, as a supplement to the ontological grounding already provided by Bunge. In some of the early analyses they seem to rely mostly on the formal properties of their model. In other analyses they rely mostly on the ontological grounding. This is the point of having a model that is both mathematically formal and ontologically grounded; you can sometimes rely on its formal properties, sometimes on its ontological grounding and often on both. But Wand and Weber never—to my knowledge—somehow "de-committed" (how could they and why should they?) their model from Bunge's original ontological commitment. I cannot remember having read any physics, chemistry or biology textbook that makes its ontological commitment explicit either. Would anyone claim that physics, chemistry and biology are therefore formal theories that do not refer to concrete things?

5 Semantics, Epistemology and Methodology

Wyssusek (2006) not only claims that "the project of ontology-based conceptual modeling appears to be impossible in principle". He also claims that when they developed their model, Wand and Weber "not only ignored the larger part of [Bunge's treatise], but also the, for conceptual modeling, most relevant parts". Instead, Wyssusek points to Bunge's "Semantics" (1974a; 1974b) and his "Epistemology & Methodology" (1983). This reflects an earlier argument by Rosemann and Wyssusek (2005, p. 2804) that "for the sake of consistency and theoretical soundness, salient concepts of Bunge's semantics should become part of the BWW ontology". But Wyssusek and his collaborator do not make it clear that Bunge's "Semantics" and his "Epistemology & Methodology" are not about meaning and knowledge in worklife and everyday life. Instead, they are a semantics *of scientific theories* and an epistemology and methodology *of scientific methods*.

The preface to Semantics I states that "The central aim of this work is to constitute a semantics of science" (Bunge 1974a, p. xi). It is therefore a bit imprecise when Wyssusek (2006, p. 74) claims that Bunge (1974a, pp. 83-114) devotes a whole chapter to "conceptual representation *and issues of conceptual modelling*" (my emphasis). And it is a bit imprecise when Rosemann and Wyssusek (2005, p. 2806) claim that "Bunge explicitly deals with the semantic issues of *modeling*" (my emphasis again), citing Bunge (1974a; 1974b) as their example. The reason is that, although Bunge does use the terms "representation" and "modeling", he uses them in a (scientific) way that is different from what is usual when discussing conceptual modelling in the IS field. What Bunge (1974a, 1974b, 1983) explicitly deals with is first of all issues of *scientific theorising*. For example, the most developed parts of Bunge's semantics focus on axiomatically organised theories, but few mainstream conceptual modelling languages have such an explicit axiomatic structure. Accordingly, few conceptual models need to be established and justified with the scientific rigor promoted by Bunge's epistemology and methodology.

Hence, Bunge's semantics, epistemology and methodology are obviously not relevant for conceptual modelling because conceptual modelling is not a scientific activity. Of course, they may inform conceptual modelling practice and research in a productive and useful way, but their usefulness must be evaluated through practice and research. It is not given by argument alone.[7]

6 Conclusion

Wyssusek criticizes Bunge for his "rather disquieting polemic". In contrast, Wyssusek wants "to open up a debate". But he ends up referring to research using the BWW model as "dysfunctional discourses", "impossible in principle", "neither feasible nor defensible" and based on "fundamental misconceptions" which are "bound to prosper" due to these researchers' "lack of critical reflection" (Wyssusek 2006, p. 74). Such strong language needs to be backed up by flawless argument. But Wyssusek's claim that the BWW model has not been critically evaluated can be dismissed by reference to existing work. His discussion of conceptualisations does not distinguish carefully between what a scientific ontology *is* and what it *is about*. His claim that the BWW model is a formal and not a factual model does not account for the many parts of the body of existing work that can only be understood in the context of Bunge's ontological commitment. His promotion of Bunge's semantics, epistemology and methodology as alternatives to Bunge's ontology fails to make it clear that they are a semantics, epistemology and methodology *of science* and therefore not obviously relevant for conceptual modeling.

Wyssusek's debate contribution illustrates how difficult it can be for the IS community to deal with controversy at an almost purely philosophical level. It also illustrates why ontological models for conceptual modelling should primarily be evaluated according to how well they inform conceptual modelling practice and research. For my own part, I consider this near philosophy-level response an exception, although I have attempted to tie it as closely to IS practice and research as I can. For the same reason, I have not responded to Wyssusek when he criticises Bunge's ontology independently of the BWW model. For example, Wyssusek's contribution to the millennium-old discussion between ontological realists and idealists belongs in philosophical fora, not on the IS scene.

Notes

1. Wand and Weber originally proposed three models: a representation model, a state-tracking model and a good-decomposition model. Today, the term "BWW model" is often used synonymously with Wand and Weber's *representation model*. This is how the term will be used in this response.
2. This is not an attempt to criticise object orientation and OO technology per se. Of course, they have had a profound and positive impact on the IS field. But when OO-modelling techniques are used uncritically for representing human

organisations, IS users and their problem domains, it too easily leads to seeing these parts of the world through software lenses.

3. Opdahl and Henderson-Sellers (2002) demonstrate the same point for UML 1.4.
4. My own attempt to analyse UML using the latter had to be abandoned because Chisholm's (1996) ontology provided—for my use—insufficient behavioural and systemic concepts. I was not able to move beyond UML's simpler static diagram types.
5. Admittedly, researchers who use the BWW model and Bunge's ontology often take conceptualisations for granted when they write. But in a quote, such as Wyssusek's above, *that deals specifically with conceptualisations* one needs to be explicit.
6. Wyssusek (2006) even lists the above quote, and several similar ones, but does not take them into account later when he presents a summary of WAND and Weber's justifications.
7. Having said that Bunge's "Semantics" and "Epistemology & Methodology" primarily belong to the philosophy of science, we should of course admit that the same applies to Bunge's Ontology. It is an ontology that is based on the sciences. But this may be less problematic. I argue that the epistemological requirements of scientific methods are more rigorous than those of work life and everyday life. And the semantics of scientific theories must be established in a more rigorous way than the semantics of work life and everyday concepts. But according to a realist position, science, work life and everyday life all confront the same concrete reality. Therefore they must be ontologically close. In the end, whether this is the case in the IS field can best be answered through IS practice and research.

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