Panel: Foundations of Information Systems

Peter Green (Chair)[1]
Simon Milton[2]
Robert Colomb[3]
Kit Dampney[4]

[1] Department of Commerce
The University of Queensland
Ipswich, Australia
Email: p.green@mailbox.uq.edu.au

[2] Department of Information Systems
The University of Melbourne
Melbourne, Australia
Email: Smilton@staff.dis.unimelb.edu.au

[3] School of Computer Science and Electrical Engineering
The University of Queensland,
Brisbane, Australia
Email: colomb@csee.uq.edu.au

[4] Department of Computing
Macquarie University,
Sydney, Australia
Email: cdampney@ics.mq.edu.au

Abstract

The Information Systems discipline has been criticised in a number of sources for lacking sound theoretical foundation. The aim of this panel is to discuss this issue. In particular, the panellists will focus on Ontology and its potential usefulness as a theoretical foundation for information systems modeling and development. In this session, ontology will be explained, different ontologies will be presented, and their explanatory power for the Information Systems discipline explored. The results of empirical research based on the various ontological foundations will be presented also.

Keywords

IB01 IS research methodologies, IB02 IS research frameworks, IB03 IS research issues, IA01 IS curriculum.

INTRODUCTION

This panel aims to discuss the issue of theoretical foundations for the discipline of Information Systems. In particular, the panellists will present their views in the light of their research and experiences with the use of *Ontology* - an area of philosophy that explains the meaning of things in the real world - for explaining problems and issues that information systems professionals encounter when they are modeling and developing computer-based systems.

An underlying theme through the panellists' presentations is that the discipline of Information Systems requires the following steps to progress. First, it needs an underlying theoretical domain. Second, it needs to be able to communicate the constructs of this domain to members inside and outside the community using some commonly understood “language”. Third, we need to apply these constructs to purposes that are of interest to users, particularly business users. Fourth, the constructs need to be testable for success or failure in effective application, synthesis with accepted approaches, and by the rigour of mathematics. Finally, the application of the constructs needs to take into consideration the fact that users in various situations work under constraints, in particular in business, the need for cost effectiveness.

USING ONTOLOGY TO UNDERSTAND DATA MODELLING LANGUAGES (Simon Milton)

The study of ontology has been suggested as a source of theory that can be used to understand aspects of representation in information systems (Weber, 1997; Wand and Weber, 1990; Wand et al., 1995; Wand 1996) development. In this context ontology is the study of 'what there is' in its broadest sense: "Ontology is the study of being in so far as this is shared in common by all entities, both material and immaterial. It deals with the most general properties of beings in all their different varieties" (Kim and Sosa, 1995).

An ontology proposes a categorisation of everything that exists but using terms that are most general (Honderich, 1995). For example, categories such as thing or individual, property, event and so on are described and defined. A description of ontology often includes a discussion of how these categories can be used to describe to a specific reality (often called a state of affairs by philosophers). Most importantly, an ontology tells you what sorts of things one needs to make sense of what there is, but it will not tell you how to model what there is.

Our position is that an ontology will help us to sharpen our data modelling languages and tools. This can be achieved by gaining a deeper understanding of the categories in an ontology and then using this deeper understanding to better understand the various parts of data modelling languages.

Ontology seems to offer much in theoretically examining data modelling languages. Indeed two ontologies (Bunge, 1977 & 1979; Chisholm, 1992 & 1996) have now been applied in theoretical studies of data modelling languages (Wand et al., 1999; Parsons and Wand, 1997; Weber and Zhang, 1996; Milton, 2000; Milton, et al., 1998; Milton, et al., 2000) and other modelling tools (Green, 1996; Rhode, 1995; Wand and Weber, 1989) used in information systems. However, the two ontologies used are qualitatively different ontologies.

We are interested in answering three questions that arise when considering using ontology with data modelling languages

- What perspective will an ontology give you in understanding data modelling languages?
- How do you get information out of an ontology?
- What do different ontologies tell us?

WHERE DOES THE ONTOLOGY BOTTOM OUT? (Robert Colomb)

Ontologies are collections of terms with a more or less complex structure, most often used to support interorganisational interoperability. The question is, what are the primitives? I contend that the primitives must be grounded in more-or-less explicit agreements among the parties. The contracts, the standard business practices as formulated in EDI, agreed primitive terms for the product catalogs, prices, etc, all supported by a legal and audit environment. The structural relationships are grounded in more general agreements that take the form of mathematical systems that are standardised in the educational systems of the developed world.

Interactions among parties involve nouns, verbs and behavioural norms. In the world of organisational interoperability, the ontology agreed among the parties provides the nouns. The verbs are either messages representing speech acts or recording physical actions taken as a result of speech acts. So far as the information systems are concerned, the verbs are members of standardised genres of messages - this is what EDI is all about. The interaction is mediated by an agreed set of EDI message types containing agreed elements. The behavioural norms are in the first instance specified by policies represented in contracts among the parties. The policies specify what can be done, what must be done and what must not be done.

All of this happens in a global context, where the major structural relationships are essentially implicit. In some cases the structural relationships are grounded in widely understood semiotic systems, such as arithmetic or the first order predicate calculus, which are widely taught in educational institutions. The remainder are elements of the basic linguistic and behavioural repertoire that as Wittgenstein says in the *Tractatus Logico-Philosophicus* are "pointed to" rather than defined, for example a sequence (Wittgenstein's thesis is that it is impossible to define what we mean by sequence without using knowledge of sequences.)

SO WHAT IF INFORMATION SYSTEM FOUNDATIONS REQUIRE BOTH SOCIAL AND TECHNOLOGY CONTEXT? (Kit Dampney)

We follow Weber's (1997) proposal that representation is the essence of information systems. Representing information systems may be by precise description using the language of mathematics, by the mechanisms of the computer or as information perceived within our minds. An ontology such as the Bunge-Wand-Weber (BWW) ontology posits the information constructs we use within our thinking to perceive a reality.

How these representations are realised, how to transform between them, and whether the ontology is adequate tests the foundations of information systems. To answer these questions formal description is essential and the system's context must be made as explicit as possible.

We present empirical evidence from very large information models to show that effective representation requires understanding context, including social norms, business rules and the supporting technology. These are also essential for reliable interpretation and communication of information between people. Representation requires understanding the nature of systems as a complex whole and by its components. This means reducing the system to its underlying structures which thus frame its social purpose and business function.

Weber (1997) has identified the representation model, the state-tracking model and the decomposition model as the essential models that can test an ontology of information systems. We propose mathematical theory that links these models to systems specfication (representation) theory accepted elsewhere.

These foundations - representation based on ontology and context, are evident. They need a mix of approaches to investigate them, some well practiced in the social sciences, others in engineering, science and mathematics.

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