Proceedings of QualIT2005: Challenges for Qualitative Research: 23-25 November 2005, Brisbane, Australia. Hosted by the Institute for Integrated and Intelligent Systems, Griffith University.

Developing Ontological Theories for Conceptual Models using Qualitative Research

Jan Recker
Queensland University of Technology

Faculty of information Technology
Queensland University of Technology
Brisbane, Queensland, Australia
Email: j.recker@qut.edu.au

Abstract

Conceptual modelling is believed to be at the core of the IS discipline. There have been attempts to develop theoretical foundations for conceptual models, in particular ontological models as axiomatic reference systems. Although the notion of ontology has become popular in modelling theories, criticism has risen as to its philosophical presuppositions. Taking on this criticism, we discuss the task of developing socially constructed ontologies for modelling domains and outline how to enhance the expressiveness of ontological modelling theories by developing them via qualitative research methods such as Grounded Theory.

INTRODUCTION

Conceptual modelling, i.e. the description of relevant facets of a certain universe of discourse that should be represented through the artefact to be developed, is believed to be a core means within the requirements engineering phase of Information Systems (IS) analysis and design. The quality of conceptual models is believed to have an enormous impact on to the artefacts to be engineered, as conceptual models used in the requirements engineering phase of a system development process determine the acceptability and usability of the product to be built (Lauesen and Vinter, 2001). The importance of an adequate problem and domain representation through conceptual models is recognized, as they may reveal errors such as faulty requirements specification in an early stage of systems development.

Conceptual models gained quite some interest in IS Research, resembled on the one hand by a plethora of available modelling approaches - think of Entity-Relationship Models or the UML notation, and on the other hand by research that has focused the theoretical foundation of such modelling activities, e.g. (Falkenberg et al., 1998, Siau et al., 1996), amongst them approaches based on the notion of ontology.

Over the last decades, ontology respectively ontologies have attracted significant attention, e.g. (Hirschheim et al., 1995, Milton and Kazmierczak, 2004, Weber, 1997, Winograd and Flores, 1986). However, the concept of ontology, as used in contemporary IS research, draws on two different notions: While some approaches refer to an understanding of ontology in a philosophical sense, e.g. (Milton and Kazmierczak, 2004), other approaches refer to "a specification of some conceptualization", see (Gruber, 1993).We will elaborate on these different de- and connotations of ontology, with a focus on the philosophical understanding of ontology, using the example of the popular Bunge-Wand-Weber (BWW) ontology (Wand and Weber, 1990, 1995).

However, with the increased popularity of ontological theories, critical academic research in this particular field has gained momentum as well, see e.g. (Wyssusek, 2004). This criticism specifically addresses the positivist view upon research underlying modelling theories built on ontological foundations – a research paradigm that nowadays encounters a rising doubt as to its feasibility and applicability to IS research (Gregor, 2004).

This paper takes on this criticism and explores a social understanding of ontologies for conceptual modelling. More specifically, the *aim of our paper* is to outline a grounded theory-based approach to develop and validate socially oriented ontologies as theoretical foundations for conceptual modelling activities. We proceed as follows: The next section reports on our research approach and presents some philosophical dimensions relevant to this research. Next, we recapitulate the concept of the BWW ontology (as the predominant approach in IS based on ontology), report on its philosophical presuppositions discuss some findings and conclusions from this presupposition analysis. Based on this background we will discuss our grounded theory approach as to how to obtain a socially oriented understanding of ontology. We close this paper by presenting our main conclusions.

BACKGROUND

Research Approach

Addressing our research objective, the research method chosen is that of conceptual/philosophical research, in particular that of critique (in the Kantian understanding). This research method is dedicated to identifying,

scrutinizing, and questioning the presuppositions of research approaches in order to determine their scope, applicability, possibilities, and limits towards a given research objective (Kant, 1929). We will hence provide philosophical-logical arguments rather than empirical ones. However, our arguments will (where applicable) also refer to empirical research results, for instance (Chen and Hirschheim, 2004) and others. In order to increase the understandability of our forthcoming argumentations and considerations we firstly need to discuss the importance of a philosophical discussion in the field of IS research and secondly obscure some aspects of research philosophy that reveal pertinence to our research objective.

Philosophy in Information Systems Research

The IS discipline resides in an interdisciplinary context with numerous theoretical and conceptual foundations based on diverse research paradigms. This tapestry of diversity in IS research leads to an urge for publishing underlying philosophical-paradigmatic assumptions of research work so that the research perspective and approach may be fully comprehensible. Furthermore, an evaluative criticism of research work is not possible without understanding the perception of science underlying the research to be evaluated. While the debate on philosophy in IS research may or may not be seen as essential the engagement in philosophy cannot be avoided since "a good part of the answer to the question "why philosophy?" is that the alternative to philosophy is not no philosophy but bad philosophy. The 'unphilosophical' person has an unconscious philosophy, which they apply in their practice – whether of science or politics or daily life" (Collier, 1994, p. 17). Even more, awareness as to IS research presuppositions must be seen as a mandatory aspect of rigorous science as every aspect of science is based upon philosophical commitments underlying the choice of methods and theory (Garcia and Quek, 1997).

While it is not the purpose of this research to fully investigate all parts of philosophy, it is nevertheless essential to delineate specific philosophical terms of interest, especially those that form research paradigms common to the IS discipline. Generally, a paradigm is understood as a constellation of fundamental metaphysical beliefs that make up a theoretical framework within which scientific theories can be tested, evaluated and if necessary revised (Kuhn, 1962). A number of paradigmatic frameworks have been used in the analysis of information systems research, predominant has been the work of Burrell and Morgan (1979). In this paper, we analyse common IS research paradigms based on three inter-dependent philosophical dimensions: the question of a distinctive reality view (ontology), the question of a distinctive perspective upon the nature of knowledge (epistemology), and a question of how knowledge can be verified (concept of truth). As for the following aspects, for clarification and illustration purposes we present dichotomous positions while bearing in mind that the paradigms as such are permeable – their so-called "transition zones". Hence, the paradigm distinctions drawn in Table 1 must not be used uncritically but rather as an illustrative guide.

Philosophical dimension	Positivist paradigm	Interpretivist paradigm
[I] What is the object of cognition? (Ontology)	*Ontological realism.* There is an objective reality existent independently from subjective cognition, i.e. from thought and speech (Bunge, 1977).	*Ontological idealism.* Reality is not given but socially constructed, dependant on subjective perception, cognition and language (Berger and Luckmann, 1966).
[II] Hows does one perceive an object of cognition? (Epistemology)	*Epistemological realism.* Reality can be perceived objectively without subjective distortions by a cognitive subject (Falkenberg et al., 1998).	*Epistemological constructivism.* Cognition is always "private", susceptible to a (linguistic) (re-) construction of the perception of reality (Falkenberg et al., 1998).
[III] What is true cognition? (Concept of truth)	*Correspondence theory of truth.* True statements are those which correspond with "real world facts" (Kirkham, 1992).	*Consensus theory of truth.* A statement is true if, and only if, it is rationally acceptable for everyone under ideal and optimal conditions (Kirkham, 1992).

Table 1: Popular paradigms in IS research and their philosophical dimensions

Question [I] about ontology refers to the question whether an object of cognition exists beyond subjective imagination and perception (Bunge, 1977). Ergo, a researcher has to position himself in terms of the assumption "existence of an objective reality". For simplicity reasons, we only differentiate two contrary positions (see Table 1).

Question [II] about epistemology refers to the question whether an objective (re-) cognition of concepts is possible beyond subjective perception. Again, for simplicity reasons, we differentiate two basic positions (see Table 1).

Question [III] about the concept of truth has not yet been widely considered in the IS research literature. A brief mention can be found in articles by Weber (2004) and Fitzgerald and Howcroft (1998). Nevertheless, this aspect becomes highly important in analysing, for instance, a) the influence of language on research b) conceptual modelling and modelling in general, and c) inter-personal validity/truth of research results. The concept of truth

refers to the question as to how true knowledge can be obtained and how the truth of knowledge can be verified. Again, we merely differentiate two distinct approaches (see Table 1).

As shown in Table 1, our framework facilitates the identification and differentiation of popular research paradigms in the field of Information Systems research, taking the example of positivism versus interpretivism. As evidenced by Chen and Hirschheim (2004), positivism (still) dominates IS research with interpretivism being the only real alternative so far. However, the discussion on IS research paradigms must at current be considered an open issue as several post-approaches, e.g. critical realism or radical constructivism, continue to evolve.

EXAMINING THE ONTOLOGICAL FOUNDATION OF CONCEPTUAL MODELS

Conceptual Modelling and the BWW Ontology

In the process of requirements engineering for IS analysis and design modellers are confronted with the situation that they seek to represent the requirements in a conceptual form yet do not possess an underlying conceptual structure on which such models may be based. Also, there has been continuous criticism that there is no consistent theory explaining how to arrive at such conceptual structures (Floyd, 1986). This deficit has motivated research towards a theoretical foundation for conceptual modelling. Amongst various approaches based on diverse backgrounds, such as systems theory, cognitive science or agent theory, foremost those attempts have gained a considerable popularity that draw on the notion of ontology respectively ontologies. While the latter notion (of ontologies) is prevalently used in research on artificial intelligence and refers to ontology as a taxonomy or dictionary (Uschold and Grüninger, 1996), the former notion (of ontology) in its purest essence implies a firm commitment to a certain (philosophical) *Weltanschauung*.

The philosophical theory of ontology dates back to Aristotle (1999), whose treatise on metaphysics is widely accepted as the foundation of the theory of ontology. The philosophical discipline of ontology tries to "the most pervasive features of reality, such as real existence, change, time, causation, chance, life, mind, and society." (Bunge, 2003, p. 201). In the context of IS research, several researchers have turned to this philosophical branch (Degen et al., 2001, Milton and Kazmierczak, 2004), with the most popular representative being the approach proposed by Wand and Weber (Wand and Weber, 1990, 1995).

Concerned that the lack of modelling theories would result in the development of information systems that were unable to completely capture important aspects of the real world, Wand and Weber (Wand and Weber, 1990, 1995) developed and refined a set of models for the foundation of modelling languages and the scripts prepared using modelling techniques. These models are based on an ontological theory introduced by Bunge (1977) and are referred to as the Bunge-Wand-Weber (BWW) models. Believing that computerized information systems are representations of real world systems, Wand and Weber suggest that ontology can be used to help define and build information systems that contain the necessary representations of real world constructs. Building on the scientific ontology developed by Bunge, Wand and Weber (1995)developed the BWW representation model as one of three theoretical models as a "basis for modelling information systems" (Wand and Weber, 1990, p. 1282). The application of the BWW representation model as a information systems modelling foundation has been referred to by a vast number of researchers and so the representation model is now often referred to as simply the BWW ontology. It consists of an inter-related set of categories, which can be grouped into the following clusters: things including properties and types of things; states assumed by things; events and transformations occurring on things; and systems structured around things. Due to space limitations we do not discuss the set of categories further but instead refer to its complete description in (Weber, 1997).

Regarding application areas for the BWW ontology, Weber (1997) suggests that the BWW model can be used to analyse a particular modelling language to make predictions on the modelling strengths and weaknesses of the language. He clarifies two main evaluation criteria that may be studied according to the BWW model: Ontological Completeness and Ontological Clarity together determining the expressiveness of a modelling language to provide complete and clear descriptions of the domain being modelled.

Regarding other proposed ontological theories for conceptual modelling, the work of Chisholm (1996), Degen et al. (2001) and Guizzardi et al. (2002) are to be regarded as closest to the ideas of Wand and Weber. These proposed upper-level ontologies have been built for similar purposes and seem to be equally expressive yet competing (Davies et al., 2004).

A Paradigmatic Discussion of the BWW Ontology

In the following we apply the framework introduced in the background section to ontological modelling theories in order to identify their paradigmatic presuppositions. We focus here on the BWW ontology as it denotes a widespread and popular representative of theoretical foundations for conceptual modelling based on philosophical ontology. We conclude that Wand and Weber follow a rather positivist paradigm (see Table 2).

Having identified the philosophical dimensions of the BWW ontology, we are able to discuss the implications of the paradigmatic stance upon which the BWW approach is built in order to conclude about its feasibility and applicability as a foundation of the field of conceptual modelling.

Philosophical dimension	Approach chosen in the BWW ontology model
[I] What is the object of cognition? (Ontology)	*Ontological realism.* Wand and Weber take an ontological realistic position, believing that the world is made up of things that "really exist in the world". See (Weber, 1997, p. 34).
[II] Hows does one perceive an object of cognition? (Epistemology)	*Epistemological realism.* Wand and Weber take an epistemological realistic position as they presuppose a direct relationship of models and reality, thereby defining formal schemes as suitable measures for eliminating subjective distortions. See (Wand and Weber, 1990, p. 1282).
[III] What is true cognition? (Concept of truth)	*Correspondence theory of truth.* The model notion utilized by Wand and Weber is that of representation. They value a model by its compliance to reality. Thereby, their evaluation approach is "the essence of the correspondence theory of truth". See (Wyssusek, 2004, p. 4306).

Table 2: Paradigmatic discussion of the BWW ontology

An ontological foundation via the BWW approach is restricted to research contexts adhering to the same positivist stance. This can be explained by the paradigm incommensurability thesis stating that researchers must commit themselves to a single chosen paradigm (Mingers, 2001). Multi-paradigmatic research is proscribed (Kuhn, 1962, p. 103).

We argue that, with regards to ontological theories for conceptual models, this single-paradigm commitment must be stressed even further as certain dichotomies exist between distinctive philosophical viewpoints, e.g. opposing positions representing competing theories about the obtainment of "true facts" in a model. Consequently, a shift of paradigms in a given research context would resist reconciliation or synthesis. Stressing the implications of the incommensurability thesis, it proscribes the application of positivist approaches, viz. the BWW ontology, in research contexts that adhere to paradigms different from the philosophical presuppositions of the ontological theory. Taking on the debate on positivism versus interpretivism in IS research, see for instance (Chen and Hirschheim, 2004, Hirschheim and Klein, 1989, Weber, 2004), one may actually find this outcome problematic: While positivism is still often applied in IS research, there is a rising front of critics claiming that classical positivism is defunct, see e.g. (Hirschheim et al., 1995, pp. 146-147). Even Wand and Weber apply some critical self-reflection to their approach (Weber, 1997, pp. 174-178).

Regarding an ontological theory of conceptual modelling, a positivist approach assumes a reality that is objectively existent independent from any observer; furthermore, it presupposes that the objective obtainment of facts about such reality is possible through the appliance of scientific methods. However, research in cognitive science shows that universal immediate knowledge of reality is impossible in principle (Maturana and Varela, 1980). Thus, the question has to be raised how we can prove that the reference system of modelling - the BWW ontology - itself is suitable for expressing "true" objects and relationships in "the" world. Since this question cannot be answered, we must state that the BWW ontology is as good as a foundation as any other theoretical reference system, with our without firm philosophical commitments.

Furthermore, a positivist foundation of conceptual modelling in this sense implies an ontological commitment of conceptual modelling languages. However, languages are ontologically neutral (Bunge, 1974). A language – such as conceptual modelling languages – provides elements, which, put together in accordance to some rules, express statements in the form of sentences. The language itself, however, does not declare what the elements of the language refer to. The meaning of such sentences is based on our understanding of the language, viz. on an agreement on the semantics of the language elements. The importance of such agreement on the use of language in the context of information systems is clearly visible in the definition of IS research: "research in the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomena that emerges when the two interact" (Lee, 2001, p. iii). Accordingly, the framework of information systems concepts (Frisco) states that "information systems concern the use of information by persons or groupings of persons in organisation, in particular through computer based systems" (Falkenberg et al., 1998, p. 26). They further elaborate that the communication of conceptions or models is at the core of information systems, with the objective of establishing sufficient agreement and consensus between the actors about the conceptions underlying the communicated models to enable adequate action (Falkenberg et al., 1998, p. 21). Bearing this in mind we seek to develop modelling theories that address the establishment of consensus-oriented communication to allow for effective action. So, to successfully develop a foundation for conceptual modelling (languages) we must be concerned with semantic and linguistic aspects rather than with ontology – a fact that has already been noted by Bunge (1974) himself.

Concluding, we find that clinging to positivist research assumptions hinders if not contradicts the possibility of grounding conceptual modelling activities in ontology. In accordance to the propositions of the Frisco report we argue that conceptual models in the Information Systems discipline are predominantly a means of communication between actors in a domain. The objective of such models is then the establishment of a consensus between the actors in order to effectuate adequate action. Our preceding discussion revealed that ontological theories such as the BWW ontology present a priori-given sets of conceptions or conceptual categories that hold the promise of foundational knowledge related to the analysis and development of information systems via conceptual models. Such claim is, from the viewpoint of cognitive science of linguistics, however questionable as objective immediate knowledge of some reality is impossible in principle.

Yet, we still believe in the usefulness of ontology to the field of conceptual modelling. Accordingly we do not argue that the BWW ontology is useless to the task of conceptual modelling, let alone to the IS discipline in general. Rather, we want to raise awareness as to the obstacles of ontological theories for conceptual modelling. We believe we can enhance the expressiveness, and thus the applicability, of ontological theories by finding a way to develop and validate ontological propositions via qualitative research methods. Hence, we will discuss the necessity of deploying qualitative research methods in order to overcome the paradigmatic limits of ontological theories, as they are presented up to today.

QUALITATIVE RESEARCH AND ONTOLOGICAL THEORIES

Towards a Social Understanding of Ontology

We conclude from the preceding investigation that, in order to understand conceptual models as a means to create consensus about certain private conceptions and to establish communication in a certain domain with the objective of enabling effective action within that domain, we need to discuss the relationships of language, cognition and knowledge. Especially, we will discuss findings on the influence of language towards cognition and epistemology, *i.e.* how language shapes and mediates our access to reality and "knowledge" about the world.

First, our perception of some reality domain is dependant on our physiological sensory apparatus (Maturana and Varela, 1980). Ergo, we cannot assume that some reality exists (or can be perceived) independently from its observer. Hence, we cannot describe reality objectively by means of some ontological model as we cannot equate the process of reality perception for everyone. Winograd and Flores (1986, p. 10) point out that "phenomena of interpretation arise as a necessary consequence of the structure of biological beings." Second, we interpret reality dependant on our cognitive structures and our cultural and contextual background; all association of perceptual input to cognitive concepts occurs dependant on our pre-understanding of the context. Thus, interpretation is contextual, depending on the moment of interpretation and the horizon brought to it by the interpreter (Gadamer, 1989). Third, perception and interpretation of some reality domain is shaped and mediated through our language. Language defines and restricts our perception of the world and our knowledge about it (Quine, 1960). Wittgenstein (1981) uses the analogy of the visual field and the fact that the eye itself is not included in it to propose the claim that it is the linguistic system that shapes the constitution of knowledge. Hence we have to understand that language and knowledge are not only related but inseparable. These findings are of paramount importance as they highlight the individual in perceiving reality and thus in cognition and knowledge obtainment. Regarding the constructs defined in an ontology, we must understand that such an order of things or concepts is not a priori given but constructed by means of language (Barthez, 1988, p. 180).

Based on these findings we argue for an understanding of ontology that does not imply a firm commitment to positivist presuppositions. To be more precise, we advocate Gruber's perception of ontology when reconsidering ontological models as theoretical foundations for modelling activities: "An ontology is an explicit specification of a conceptualization" (Gruber, 1993, p. 199). That is, an ontology is a description of the concepts and relationships that can exist for a community of actors. This definition is consistent with the usage of ontology as set-of-concept-definitions, but more general.

This perception of ontology as a shared explicit specification of a conceptualization (of some domain) stresses two points: a) knowledge, and thus ontology is language-bound, and b) knowledge, and thus ontology is deemed a shared specification – that implies that a social understanding of the conceptualization that is being specified within the ontology is needed and must be ensured.

Contemplating these conclusions before the background of a theoretical foundation for conceptual modelling, an ontology may be seen as *one* language-specific specification of a domain conceptualization. An ontology is then some sort of language system by itself. As such, its expressiveness is not a priori given; i.e. the meaning of linguistic expressions (such as ontological categories) is not fixed as the elements of a language are multivalent in their semantic significance. Ergo, the ontology and the categories or concepts within it is itself a social construction and thus we need to ensure a socially agreed shared understanding of the meaning of the ontology

and its concepts if we want to adopt such ontology as an agreed foundation for modelling activities within some domain. This argumentation can be reasoned via the semiological triangle (Ogden and Richards, 1923).

According to Figure 1 three concepts have to be distinguished when discussing language: A language (in our case, an ontological model of some domain) consists of *symbols* (S), i.e. some physical signs. These signs symbolise (θ) certain *thoughts* (T) of certain individual(s), i.e. fictional objects that carry a certain meaning (in our mind). In our mind we refer (φ) to certain *referents* (R), i.e. factual objects in "our" reality, through these thoughts. Ergo, we have no direct relationship between symbols and referents; the relationship is instead implicitly constructed through a thought.

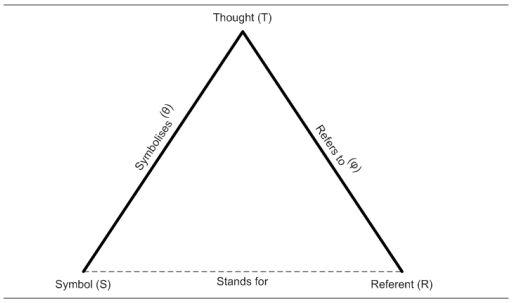

Figure 1: Semiological triangle. Adapted from (Ogden and Richards, 1923)

We conclude that a conceptual modelling ontology (using the example of the BWW ontology) is itself an individual linguistic construction and hence cannot provide symbols that explicitly and objectively stand for factual objects in some reality. It merely provides us with a formalized set of symbols including a proposed designation of thoughts related to these. Thus, we cannot presuppose that the BWW ontology actually tells us something about a domain of concern unless we enable such an understanding by designating its symbols to some of our thoughts about the domain.

Accordingly, for developing a theoretical foundation for conceptual modelling by means of ontology, we need to establish agreement about conceptions that enables us to interpret the symbols (the ontological categories) in such a way that they in fact describe what they are assumed to represent. We argue here for a social, interpretive approach to this question, viz. the obtainment of a *consensus* about the meaning of the ontology. This would effectuate a shared understanding of the ontological concepts – which applies to Gruber's understanding of ontology. This approach follows the notion of social constructionism. Its basic tenet is "the redefinition of social realities as constituted through discourse" (Neimeyer, 1998, p. 135). Referring back to the philosophical dimensions introduced in the background section we conclude that this tenet can be considered a sibling to interpretivism, with its focus on consensus theories of truth (Kirkham, 1992) and socially constructed realities (Berger and Luckmann, 1966). Ergo, we need to validate our theory (an ontology as a foundation for conceptual modelling) by socially negotiating the construction of the concepts in it with respect to their reference to some factual concept of interest in our domain. Again, this finding aligns with the postulates of the Frisco framework (Falkenberg et al., 1998).

In our belief, this proposition stresses the need for *Grounded theory* as an appropriate means for such a task. Even more, as we underlined the fact that we cannot observe some reality objectively but rather are concerned with interpretations of some domain, there is an immanent need for qualitative research methods in order to identify, analyse and coherently deploy such interpretations in such a manner that we may successfully found conceptual modelling in (an interpretive) ontology.

The Case for Qualitative Research: Towards a Research Agenda

Following our preceding considerations and referring back to the semiological triangle depicted in Figure 1, we have to address the following concepts when establishing an interpretive understanding of domain ontologies.

As discussed, a domain of interest – the referent (R) – cannot be perceived objectively; thus we cannot capture relevant domain knowledge directly in an ontology. Instead, as language defines and mediates our access to (some) reality, and thus to the domain, we perceive the particular domain as a conceptualization in the form of an internal model – a conception, or thought (T). This act of perception is by itself an interpretation of – some reference (φ) to – the domain of interest, as we for ourselves assign certain concepts to certain referents in "our" reality. We interpret perceived objects in accordance to our purpose in this moment. It has also to be noted that the assignment (φ) of concepts in our thoughts to the referred domain, i.e. the conceptualization (T), is an individual, cognitive act and can thus not be equated for everyone.

In order to arrive at a shared understanding about the individual conceptions of the domain in question we need to analyse the symbolic interactions between actors in the community following their language actions which are

based on their conceptualizations. Thus, we need to form a *consensual domain* (Winograd and Flores, 1986) in the form of interlinked patterns of activity. It is only within particular communities that we can objectify the meaning of some conceptualization. Again, such procedure is itself restrained by limits: The same conceptualization amongst all community actors cannot be established; however, a sufficient understanding of the conceptualization can be derived so that it enables a correspondence across the community to communicate and thus act effectively. Maturana and Varela (1980, p. 50) stress this point: "The basic function of language as a system […] is not the transmission of information or the description of an independent universe about which we can talk, but the creation of a consensual domain of behaviour between linguistically interacting systems through the development of a cooperative domain of interactions."

Following the consensus theory of truth we argue that a *social consensus* about a domain conceptualization needs to be established. A "social objectification" of a conceptualization across a community by means of (formal) language, such as on ontology, is dependant on the creation of a common language practice, which implies a *commitment* to the language (here: the ontology) – a set of symbols (S). Language, and thus the ontology, is thereby directed towards the creation of mutual orientation. We have to ensure that the concepts provided within the ontology correctly denote – or symbolize (θ) – the conceptualization of the domain. Following an interpretive approach to science, we argue that this can be achieved by obtaining a *consensus* about the denotation of the conceptualization by the ontology constructs. That is, we have to express and legitimate a commitment to the denotation of our individual conceptions by means of a somehow defined and formalized language – in the form of an ontology – in a way that this social reality – what Berger and Luckmann (1966, p. 95) call a "symbolic universe" – is agreed upon within the community.

We argue that the deployment of qualitative research methods facilitates the process of socially negotiating such proposed conceptualizations of some domain within ontologies and may thus ultimately lead to a social consensus about a modelling reference system that in turn enables adequate communication and interaction across the community of actors. Qualitative research addresses social aspects and individual perspectives as it seeks rich description of phenomena and strives to capture the essence of such by utilizing descriptions from various perspective angles based on empirical observations (Glazier, 1992). We do not want to take on the debate of qualitative versus quantitative research in different philosophical settings, see for instance (Kaplan and Duchon, 1988), and instead merely note that as we seek to understand phenomena through the meanings that people assign to them we deploy qualitative research methods in a rather interpretive than positivist setting. In particular we argue that our line of thought is aligned to the research method of grounded theory (Glaser and Strauss, 1967, Martin and Turner, 1986). This approach seems to complement our argumentations for several reasons:

First, grounded theory is "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin and Turner, 1986, p. 141).Since we argue for the need of understanding the development of an ontological foundation of modelling activities within a domain as a negotiation process on the conceptualizations of that domain across all actors, we need to find out about these conceptualizations first. A major purpose of grounded theory is to begin with the data and use them to develop a theory. Applied to our research context, grounded theory provides a set of procedures to gathering data, here: information about conceptions of individual actors, and constructing a theoretical model from them, here: an ontology as a socially accepted language to communicate these conceptions. Strauss and Corbin (1994) argue correspondingly that grounded theory studies typically examine people's actions and interactions. *Second*, a major premise of grounded theory is that contextual complexities and particularities need to be incorporated into an understanding of a particular phenomenon (Orlikowski, 1993). This aligns with our argumentations that one's access to some reality is that of an interpretation based on one's understanding and usage of language, one's purpose and objective, and the respective context. *Third*, grounded theory is a research method that seeks to develop theory that is grounded in data systematically gathered and analysed – it suggests that there should be a continuous interplay between data collection and analysis. This goes alongside our perception that the task of developing foundational domain knowledge for the purpose of conceptual modelling is of iterative, continuous nature as we seek to describe and understand social phenomena – shaped by the people within the domain.

Concluding, we believe that the development of such socially agreed (ontological) theoried can be reconciled with the rationale for grounded theory: "Theory derived from data is more likely to resemble the "reality" than is theory derived by putting together a series of concepts based on experience or solely through speculation" (Strauss and Corbin, 1998, p. 12). We first seek to find out about all the individual conceptions and then seek to develop a theoretical model in form of an ontology that captures the essence of these conceptions.

As for methodical guidance, we advocate the following procedures in accordance to the general guidelines to grounded theory studies (Martin and Turner, 1986, Strauss and Corbin, 1998):

- *Data collection*: Focus is to be spent on the collection of data as to the interpretation of the domain in question by the actors within it. We particularly deem the method of Delphi studies (Linstone and Turoff, 1975) as an appropriate means to be applied in a grounded theory approach towards the development of a social foundation of conceptual modelling in the form of an ontology. Our selection is based on the following reasons: (1) The Delphi method makes use of a panel of experts from whom information and expertise about a specific domain is solicited through an iterative number of (semi-structured) questionnaires. Thus, it allows obscuring the particularities of the domain of interest through the help of agreeably well-informed individuals and converging their experiences and insights through a consensual process. I Delphi studies rely on in-depth interviews that have a flexible and dynamic style of questioning and discussion directed toward understanding the significance of human experiences from the informant's perspective (Minichiello et al., 1995, p. 12). (2) Okolis and Pawlowski (2004) indicate that the Delphi method is of particular usefulness in terms of concept/framework development where studies typically involve the process steps of (a) identification of a set of concepts and (b) classification respectively taxonomy development.
- *Open coding*: In general, open coding is a process of reducing the data to a set of themes or categories that appear to describe the phenomenon under investigation. The analysis of the qualitative data gathered involves identifying categories or themes and properties in the data. Such category is a conceptual element of a theory – an abstract representation of something identified through the data as being significant. Here, these categories resemble exactly the conceptions that will build the set of categories within the ontology to be developed. The process of coding can be supported through qualitative software tools such as NVivo or Leximancer.
- *Theory development*: The categories that emerged from the coding of data are then to be organized in a way that resembles their relationships. This involves taking the concepts that emerged during open coding and reassembling them with propositions about their relationships. These emerging propositions form a theoretical framework, here: an ontological model. As we seek to develop such ontology as a consensual agreement across the community rather than using a pre-defined set of categories, grounded theory ensures that the categories and properties, and its integrated theory emerges from the data; it is not preconceived or forced upon the data (Glaser and Strauss, 1967).
- *Verification*: The theoretical model, here: the domain ontology, is then to be verified so that the propositions within the ontology, addressing the set of categories and its inter-relationships can be tested within the community to ensure it adequately enables communication and interaction. Grounded theory, in general, is seen as a method for building theory, not verifying it (Glaser and Strauss, 1967, p. 103). Hence, at this stage, alternative research methods should be applied to sufficiently validate the proposed ontology. This guideline is antithetic to the typical assumption of grounded theory suggesting that since the theory developed is grounded in data, it has somehow been verified (Glaser and Strauss, 1967).

SUMMARY & CONCLUSION

In this paper, we argued that the presuppositions of a theoretical foundation for conceptual modelling based on philosophical ontology – using the example of the BWW ontology – hinder its own purpose of being a foundation for conceptual modelling activities. Instead, we elaborated on an interpretive understanding of an ontological foundation for conceptual modelling based on the negotiation of social consensus about domain conceptualizations. Concluding from our discussion, we outlined an approach as to how to use grounded theory in order to develop at such social understanding of an ontological foundation for conceptual modelling.

Concluding, we believe that by following our outlined research design we will be able to develop an ontology as a language system to create a consensual commitment to a conceptualization of the domain of interest. Thereby, we can achieve the same outcome that was intended by, for instance, the original BWW ontology: We create an agreed modelling reference system in our domain of interest. But instead of grounding such a foundation in preconceived beliefs upon the existence of real world "things" and objects", we build our ontological theory on shared, consensual interpretations of "our" reality so that in turn adequate interaction and activity across the community is agreeably facilitated.

REFERENCES

Aristotle (1999) *The Metaphysics,* Penguin Books, London.

Barthez, R. (1988) *The Semiotic Challenge,* Hill & Wang, New York.

Berger, P. L., and Luckmann, T. (1966) *The Social Construction of Reality: A Treatise in the Sociology of Knowledge,* Doubleday, Garden City.

Bunge, M. A. (1974) *Treatise on Basic Philosophy Volume 2: Semantics II - Interpretation and Truth,* Kluwer Academic Publishers, Dordrecht.

Bunge, M. A. (1977) *Treatise on Basic Philosophy Volume 3: Ontology I - The Furniture of the World,* Kluwer Academic Publishers, Dordrecht.

Bunge, M.A. (2003) *Philosophical Dictionary,* Prometheus Books, New York.

Burrell, G., and Morgan, G. (1979) *Sociological Paradigms and Organizational Analysis: Elements of the Sociology of Corporate Life,* Ashgate Publishing, Brookfield.

Chen, W. S., and Hirschheim, R. (2004) A Paradigmatic and Methodological Examination of Information Systems Research from 1991 to 2001, *Information Systems Journal,* 14, 197-235.

Chisholm, R. M. (1996) *A Realistic Theory of Categories: An Essay on Ontology,* Cambridge University Press, Cambridge.

Collier, A. (1994) *Critical Realism: An Introduction to Roy Bhaskar's Philosophy,* Verso, London.

Davies, I., Green, P., Milton, S., and Rosemann, M. (2004) "Analysing and Comparing Ontologies with Meta Models" in J. Krogstie, T. Halpin and K. Siau (eds.) *Information Modeling Methods and Methodologies*, Idea Group, Hershey, pp. 1-16.

Degen, W., Heller, B., Herre, H., and Smith, B. (2001) "GOL: A General Ontological Language" in C. Welty and B. Smith (eds.) *Proceedings of the International Conference on Formal Ontology in Information Systems*, ACM Press, Ogunquit, pp. 34-46.

Falkenberg, E. D., Hesse, W., Lindgreen, P., Nilsson, B. E., Oei, J. L. H., Rolland, C., Stamper, R. K., van Assche, F.J.M., Verrijn-Stuart, A.A., and Voss, K. (1998) *A Framework of Information System Concepts. The FRISCO Report,* International Federation for Information Processing WG 8.1, Web version: http://www.mathematik.uni-marburg.de/~hesse/papers/fri-full.pdf.

Fitzgerald, B., and Howcroft, D. (1998) "Competing Dichotomies in IS Research and Possible Strategies for Resolution" in J. I. De Gross, R. Hirschheim and M. Newman (eds.) *Proceedings of the 19th International Conference on Information Systems*, Association for Information Systems, Helsinki, pp. 155-164.

Floyd, C. (1986) "A comparative evaluation of system development methods" in T. W. Olle, H. G. Sol and A. A. Verrijn-Stuart (eds.) *Information System Design Methodologies: Improving the Practice*, North-Holland, Amsterdam, pp. 19-54.

Gadamer, H.-G. (1989) *Truth and Method,* Continuum, New York.

Garcia, L., and Quek, F. (1997) "Qualitative Research in Information Systems: Time to be Subjective?" in A. S. Lee, J. Liebenau and J. I. De Gross (eds.) *Information Systems And Qualitative Research*, Kluwer Academic Publishers, Boston, pp. 444-465.

Glaser, B. G., and Strauss, A. L. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research,* Aldine Publishing Company, Chicago.

Glazier, J.D. (1992) "Qualitative Research Methodologies for Library and Information Science: An Introduction" in J. D. Glazier and R. R. Powell (eds.) *Qualitative Research in Information Management*, Libraries Unlimited, Englewood, pp. 1-13.

Gregor, S. (2004) "The Struggle Towards an Understanding of Theory in Information Systems" in D. Hart and S. Gregor (eds.) *Proceedings of the Information Systems Workshop: Constructing and Criticising*, School of Business and Information Management, Canberra, pp. 1-11.

Gruber, T. R. (1993) A translation approach to portable ontology specifications, *Knowledge Acquisition,* 5, 199-220.

Guizzardi, G., Herre, H., and Wagner, G. (2002) "On the General Ontological Foundations of Conceptual Modeling" in S. Spaccapietra, S. T. March and Y. Kambayashi (eds.) *Proceedings of the 21st International Conference on Conceptual Modeling*, Springer-Verlag, Tampere, pp. 65-78.

Hirschheim, R., and Klein, H. K. (1989) Four paradigms of information systems development, *Communications of the ACM,* 32, 1199-1216.

Hirschheim, R., Klein, H. K., and Lyytinen, K. (1995) *Information Systems Development and Data Modeling. Conceptual and Philosophical Foundations,* Cambridge University Press, Cambridge.

Kant, I. (1929) *The Critique of Pure Reason. Translated by NormanKemp Smith,* St. Martin's Press, New York.

Kaplan, B., and Duchon, D. (1988) Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study, *MIS Quarterly,* 12, 571-586.

Kirkham, R. L. (1992) *Theories of Truth: A Critical Introduction,* The MIT Press, Cambridge.

Kuhn, T. S. (1962) *The Structure of Scientific Revolutions,* Chicago University Press, Chicago.

Lauesen, S., and Vinter, O. (2001) Preventing Requirement Defects: An Experiment in Process Improvement, *Requirements Engineering,* 6, 37-50.

Lee, A. S. (2001) Editor's Comments. MIS Quarterly's Editorial Policies and Practices, *MIS Quarterly,* 25, iii-vii.

Linstone, H. A., and Turoff, M. (eds.) (1975) *The Delphi Method: Techniques and Applications,* Addison-Wesley, London.

Martin, P. Y., and Turner, B. A. (1986) Grounded Theory and Organizational Research, *The Journal of Applied Behavioral Science,* 22, 141-157.

Maturana, H. R., and Varela, F. .J. (1980) *Autopoiesis and Cognition. The Realization of the Living,* Dordrecht Reidel, Dordrecht.

Milton, S., and Kazmierczak, E. (2004) An Ontology of Data Modelling Languages: A Study Using a Common-Sense Realistic Ontology, *Journal of Database Management,* 15, 19-38.

Mingers, J. (2001) Combining IS Research Methods: Towards a Pluralist Methodology, *Information Systems Research,* 12, 240-259.

Minichiello, V., Aroni, R., Timewell, E. and Alexander, L. (1995) *In-depth Interviewing: Principles, Techniques, Analysis,* Longman, Melbourne.

Neimeyer, R. A. (1998) Social Constructionism in the Counselling Context, *Counselling Psychology Quarterly,* 11, 135-150.

Ogden, C. K., and Richards, I. A. (1923) *The Meaning of Meaning. A Study of The influence of Language upon Thought and of The Science of Symbolism,* Harcourt, Brace & Company, New York.

Okoli, C., and Pawlowski, S. D. (2004) The Delphi method as a research tool: an example, design considerations and applications, *Information & Management,* 42, 15-29.

Orlikowski, W. J. (1993) CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development, *MIS Quarterly,* 17, 309-340.

Quine, W. V. O. (1960) *Word and Object,* The MIT Press, Cambridge.

Siau, K., Wand, Y., and Benbasat, I. (1996) "Evaluating information modeling methods - A cognitive perspective" in K. Siau and Y. Wand (eds.) *Proceedings of the Workshop on Evaluation of Modelling Methods in Systems Analysis and Design*, Crete, pp. M1-M13.

Strauss, A. L., and Corbin, J. (1994) "Grounded Theory Methodology: An Overview" in N. K. Denzin and Y. S. Lincoln (eds.) *Handbook of Qualitative Research*, Sage, Thousand Oaks, pp. 273-285.

Strauss, A. L., and Corbin, J. (1998) *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory,* Sage, Thousand Oaks.

Uschold, M., and Grüninger, M. (1996) Ontologies: principles, methods and applications, *The Knowledge Engineering Review,* 11, 93-136.

Wand, Y., and Weber, R. (1990) An Ontological Model of an Information System, *IEEE Transactions on Software Engineering,* 16, 1282-1292.

Wand, Y., and Weber, R. (1995) On the Deep Structure of Information Systems, *Information Systems Journal,* 5, 203-223.

Weber, R. (1997) *Ontological Foundations of Information Systems,* Coopers & Lybrand and the Accounting Association of Australia and New Zealand, Melbourne.

Weber, R. (2004) The Rhetoric of Positivism Versus Interpretivism: A Personal View, *MIS Quarterly,* 28, iii-xii.

Winograd, T., and Flores, F. (1986) *Understanding Computers and Cognition: A New Foundation for Design,* Ablex Publication Corporation, Norwood.

Wittgenstein, L. (1981) *Tractatus Logico-Philosophicus,* Routledge, New York.

Wyssusek, B. (2004) "Ontology and Ontologies in Information Systems Analysis and Design: A Critique" in J. Luftman, C. Bullen and E. A. Stohr (eds.) *Proceedings of the 10th Americas Conference on Information Systems*, New York, pp. 4303-4308.

COPYRIGHT