Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems

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Chapter 3
Postmodernism, Interpretivism, and Formal Ontologies

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ABSTRACT

This chapter investigates the relationship between postmodernism, interpretivism, and formal ontologies, which are widely used in Information Systems (IS). Interpretivism has many postmodernist traits. It acknowledges that the world is diverse and that knowledge is contextual, ever-changing, and emergent. The acceptance of the idea of more than one reality and multiple understandings is part and parcel of postmodernism. Interpretivism is, therefore, characterized as a postmodern research philosophy. To demonstrate this philosophical premise more concretely, the creation of the logical structure of formal ontologies is sketched as an example of typical interpretivist and postmodernist activity in IS.

INTRODUCTION

Humanities aspects and approaches are present and embedded in various branches of information and communication technology (ICT). One outstanding example is the increase in research on and use of "ontologies" in Information Systems (IS). This chapter investigates interpretivism as a postmodern research philosophy, as well as the problematic association between the philosophical concept of ontology and the notion of formal ontologies as it is used and researched in IS. The chapter's objective is to show that both formal ontologies and the interpretivist paradigm used to create them show very clear postmodernist traits.[1]

Although the term ontology has been borrowed by Information Systems from philosophy, it has been given a slightly different meaning. The concept has been pluralised, but the two uses of the word are still historically and logically related. The author believes that the shift – from singular to plural – was made possible by the postmodern era that we live in. Like reality, knowledge and understanding have become fluid. Software development, too, did not escape the philosophical shift from modernism to postmodernism. Indeed,

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one may also regard the creation of information systems ontologies in a positive way as the endeavour of academics to embrace the multifaceted nature of reality by representing subsets of it. On the other hand, the danger of formal ontologies is that, although they are meant to mirror and capture reality, ontology-based software could create hyperrealities that become more real than reality because it is typical of postmodernism that real life phenomena are replaced by representations.

This chapter is a purely conceptual study and no empirical methodologies are used (cf. Klein & Myers, 1999, p. 70 for a seminal paper using a purely conceptual approach). The central premise is that, although the singular and plural terms are used differently, they are still semantically related, and that postmodernism underpins the divergence in meaning. Using a qualitative approach, the chapter reflects on the intimate relationship between postmodernism, interpretivism, ICT, and formal ontologies.

After the concepts of postmodernism and interpretivism are defined and discussed, general postmodernist traits in IS and IS research are discussed. Formal ontologies are then explored as the epitome of postmodernism in this field. The chapter concludes with a critical discussion of the understanding and use of ontologies, highlighting some ironies and paradoxes, as well as dangers and opportunities.

BACKGROUND ON POSTMODERNISM AND INTERPRETIVISM

Postmodernism: A Survey of the Paradigm

Origins

The idea of multiple realities and parallel or divergent understandings is essential to postmodernist thinking. Critical theory and postmodernism both "draw attention to the social, historical, or political construction of knowledge, people, and social relations" (Mitev, 2006, p. 316). It is typical of the postmodern era that our concept of reality and knowledge is ever-changing (Tarnas, 1991, p. 395). Not only is our understanding of the world ambiguous and pluralistic, but the world itself is open and created by people: "Reality is not a solid, self-contained given but a fluid, unfolding process, an 'open universe,' continually affected and molded by one's actions and beliefs" (Tarnas, 1991, p. 396).

Since reality is not regarded as a single, concrete and objective phenomenon, postmodernists also reject an ontological priority and allow alternative readings in making sense of the world (Mitev, 2006, p. 321). Like reality, knowledge and understanding have become fluid. It is not possible to "grasp and articulate a foundational Reality" (Tarnas, 1991, p. 400). "Any alleged comprehensive, coherent outlook is at best no more than a temporarily useful fiction masking chaos, at worst an oppressive fiction masking relationships of power, violence, and subordination" (Tarnas, 1991, p. 401).

According to Harrison (2004, p. 165), postmodernism describes the current cultural and societal condition to which one could react in different ways; however, it is not a philosophical position that one could decide to accept or reject. Postmodernism may even be regarded as a new stratum in human civilisation (Siraj and Ullah, 2007, p. 1).

Postmodernism is everywhere around us, in literature, music, cinema and television (Sim, 2001a). Easthope (2001, p. 17) refers to examples in art in which the difference between the real and the apparent is cancelled, a typical example of the ambivalence inherent in postmodernism. In architecture, postmodernism comes to the fore in a "pluralistic admixture of styles" (Easthope, 2001, p. 18). In politics, groupings are fluid forming "micropolitical alliances" to promote individual issues, thus defying the traditional idea of political

parties (Grant, 2001a, p. 31). The feminist movement may also be regarded as typical postmodern since it rejects traditional authorities and aims to construct a new concept of femininity and change power relations between the sexes (Thornham, 2001, pp. 41-42).

Whereas the previous era, modernism, was characterised by technology, the new era is typified by, and even embodied in, ICT: "We are hooked up, wired in to [sic] a system" (Siraj and Ullah, 2007, p. 4). Postmodernism, therefore, represents a whole paradigm, referring to a set of assumptions regarding ontology, epistemology, methodology and axiology (the study of values). A paradigm usually refers to one set of theories which is typical of a historical phase in the philosophy of science, but in social science various competing paradigms co-exist in the postmodern era (Mingers, 2008, p. 81).

The idea of scientific paradigms "highlights the constructed, conventional nature of scientific theorising" (Mingers, 2008, p. 81). "Postmodernist themes focus on the constructed nature of people and reality, concentrate on language as central to this construction process, and argues against grand narratives such as Marxism or functionalism" (Mitev, 2006, p. 314). Master narratives are suspended due to the overwhelming offering of information that causes a fragmentation of knowledge and a lack of a central principal that guides a coherent and unified understanding of the cosmos. Totalizing theories are replaced by localizing theories (Siraj and Ullah, 2007, pp. 1-3).

"We no longer unquestioningly accept the universal claims to knowledge and truth of the great stories which have organized our culture. These include religion, the progress of modernism, the progress of science, and absolute political theories like Marxism" (Watson, 2001, p. 58). In science, knowledge is replaced by knowledges and the legitimacy of empirical proofs are questioned (Easthope, 2001, pp. 18-19). The rationalist idea that science frees people was a grand narrative, and so was the positivist idea that science represents pure, authentic knowledge (Easthope, 2001, p. 19). The dissolution of tradition is one of the characterizing features of postmodernism (Watson, 2001, p. 53). This could also be true of research traditions like empiricism and positivism. One culture is not better that another, neither is any scientific paradigm superior to another.

The far-reaching shift from modernism to postmodernism, often driven by ICT, affected even the natural sciences. The objectivist divide is not that sharp anymore. "Given this unexpected convergence between the natural and the human sciences, technology, ironically, emerges as a vital component driving and shaping postmodern culture itself" (Grant, 2001b, p. 66). Usually regarded as factual, empiricist and objective, "science has had to reinvent its own rules" leading to an incredulity to its meta-narrative which has consequently been replaced by "a series of locally applicable discourses" (Harrison, 2004, p. 165). It may even be argued that it is the remarkable development of science over the past few centuries that lead to the postmodernist trend. Yet, the drift is even more clear in the humanities and social sciences, which are traditionally regarded as "soft" sciences. For example, it is now realized and acknowledged that even historical studies do not simply reflect facts, but create realities because they are written for specific purposes – "a past is nostalgically recreated as a form of substitute reality" (Watson, 2001, p. 55). Even minutes of meetings create realities – they are historical constructions aimed at specific audiences which rarely are a precise rendering of a meeting's proceedings (Oates, 2006, p. 144). IS is regarded as a social science and one may, therefore, expect to see many postmodernist traits in its practice and research.

Use of Postmodernism in IS and ICT

Various authors have indicated that ICT has played a supporting role in the advance of postmodernism. It has been causing fundamental cultural shifts in society, including a move from reality

to hyperreality (Siraj and Ullah, 2007, p. 7). ICT and especially the internet has played a major part in compressing time and space and fragmentizing experience (Watson, 2001, p. 58-59). It has also served – and still does – to accelerate "postmodern phenomena such as globality and mobility" (Hohmann, 2007, p. 26).

ICT has caused an overload of information which undermines the viability of a single metanarrative, while multimedia and hyperlinking allow users to make their own connections and sequences, all of which results in an eclectic experience of life (Watson, 2001, p. 62). This eclectic trend has even impacted research theory and philosophy to a certain extent. The one and only "scientific method" has made way to a plethora of research philosophies and approaches, from which IS researchers may pick and mix. Mixed methods and triangulation of strategies and data generation methods have become perfectly acceptable (cf. Oates, 2006; Myers, 2009).

Science plays an important role in the construction of societies; not only scientific facts, but also science in action has enormous effects on society (Grant, 2001b, p. 67). With reference to ICT, one could only reflect on how email changed the profile of the successful worker, computer literacy the profile of the successful researcher, and internet radio the connectedness of dispersed cultural groups. Action research is often used in ICT research and the interventions may have serious consequences on the research participants and their communities. Researchers should, therefore, seriously consider the ethical implications of their intercessions. While technology, including ICT, may appear to be neutral, it is actually loaded with the ideology of the culture within which it was created. To assume that research participants' groups will experience this technology as beneficial, is a new form of imperialism. According to Sim (2001b, pp. 10-11), Lyotard was even concerned about techno-science, i.e. the reduction of humanity to thought and the movement of thought (and thus humanity) from the human body to the computer.

There is, however, a flip side of the coin. Society also has an effect on science and technology, e.g. the trend that more men are ICT professionals may be related to traditional gender roles that are (still) inherent in the related societies (cf. Grant, 2001b, p. 67). The impact of ICT and postmodernism is also bi-directional. While the postmodern temperament of multiplicity has been strengthened by information and communication technology, it now lives and thrives on it (Nel, 2007, pp. 113-117). According to Wells (1996, pp. 602-604), many advances in IT are indeed a result of postmodernism. While ICTs support and speed up cultural shifts, they are simultaneously affected by these transformations (Firat & Dholakia, 2004/2005, p. 123).

The idea that ICT is an agent of postmodernism has been noticed in other academic disciplines too. Firat and Dholakia (2004/2005, p. 124), for example, identify ICT as an instrument/mediator of postmodern marketing practice and theory. According to Conlon (2000, p. 111), ICT is strongly entangled in the postmodern paradigm shift taking place in education since it facilitates globalization, automation, consumerism and virtuality.

According to Hackney & Pillay (2002, pp. 28-29), postmodernist ideas have, however, not enjoyed a lot of deliberate attention in the IS world. They apply some of the basic trends into the IT management field, believing that a more flexible approach could provide the cultural context for mission statements, a deconstructive analysis of these statements, as well as an "ethnographic empathy for further IS/IT research". The modernist goal of a mission statement is to create a shared understanding of a company's vision and strategies, but ironically, it could highlight diverse cultures within an organisation (Hackney & Pillay, 2002, pp. 32-33).

Mingers's (2008, p. 84) plea for a pluralist approach towards IS research and philosophy is a typical postmodernist stance, although he does not present it like this himself and only mentions postmodernism fleetingly. Mingers (2008, pp. 83-

Table 1. A summary of Mingers's (2008) pluralist scientific paradigm for IS research

	Ontology	Epistemology	Axiology
Different worlds and types of knowledge	Objective/material	Observation	Pragmatic
	Social/normative	Participation	Moral
	Subjective/personal	Experience	Ethical

84) may be regarded as a critical realist since he adopts both the ideas of ontological realism and epistemological relativism. He believes that there are three different types of worlds, corresponding to three ways of understanding them, different methods to study them and different value systems for each. This may be summarized in Table 1.

Mingers's suggestion of a more postmodern approach in IS is echoed by various other scholars. Greenhill and Fletcher (2007a, p. 9) say that information systems development is grounded in a typical modernist view of static information and singular meaning. They suggest a more pluralistic approach to Information Systems research and practice that allows the incorporation of multiple non-lineal texts and meanings. Even contemporary physics is challenging the modernist principles of causality, objectivity, rationality and falsification, and suggests the use of multiple views – IS research should learn from this and implement complementary views, e.g. sociological and philosophical perspectives, in order to grow the discipline (Monod & Boland, 2007, p. 139). One example of such an attempt is a collection of papers that investigate the implementation of postmodern methods in Human-Computer Interaction. Since postmodern methods have become marginalised in academic circles, Greenhill and Fletcher (2007b, pp. i-v) reintroduce postmodernism to advocate inclusiveness and a wider understanding of the world and especially of the discipline of Human-Computer Interaction. Mitev (2006, pp. 310-312) suggests that critical research in IS be enriched by postmodern concepts, especially in terms of critique. Another attempt to pluralise research approaches in IS, is to borrow more intensely from the humanities in order to enrich IS (Kroeze, 2010; Kroeze et al., 2011).

Interpretivism: A Postmodern Research Philosophy

A research philosophy is the surrounding paradigm within and from which a school of scientists operationalizes their study and reflects on it. Myers (2009, pp. 35-44) defines a scientific paradigm as the philosophical stance that encompasses one's underlying assumptions about reality and knowledge. It influences beliefs about valid and legitimate/justifiable research. Positivism is the traditional paradigm in IS and believes in a concrete, measurable reality, which can be studied objectively. Positivist researchers try to study human and social phenomena in the same way as natural scientists study the physical world. Interpretivism, on the other hand, focuses on reality as a human construction which can only be understood subjectively. Since no researcher can distance him/herself from the social reality being studied it is important to take note of the context in order to make sense of the phenomena and to create knowledge about them. Data is interwoven with theory. The purpose of interpretivist research is to acquire meaning and understanding. In an interpretive study "[t]he generalizations derived from experience are dependent upon the researcher, his or her methods, and the interactions with the subject of study", and the validity of the research depends on its plausibility, consistency and logical reasoning (Myers, 2009, p. 40). Knowledge is much more fluid and emergent. The philosophical assumptions of critical research

are similar to those of interpretivism, but it goes further than a mere description and understanding by also challenging these issues (Myers & Klein 2011, pp. 30-32). Although this three-fold classification of research philosophies in IS has been widely accepted, critical research has received less attention than positivism and interpretivism and its principles have not been discussed in the same depth (Myers & Klein, 2011, pp. 18-19). A detailed study on the postmodernist traits of both interpretivism and critical research is desirable. This article addresses the first of these two needs.

Acknowledging that science in a postmodern world cannot always objectify nature (or its research objects), but often enters into a dialogue with it (Grant, 2001b, p. 72) resonates the characterization of interpretivism as context-bound approach to knowledge creation. Even positivist, empiricist and statistical approaches may not be as value-free and objective as it hopes and pretends to be. Postmodernism is anti-foundational – it undermines the philosophical points of departure of theories (Sim, 2001b, p. 3). "[P]ostmodernism is to be regarded as a rejection of many, if not most, of the cultural certainties on which life in the West has been structured over the last couple of centuries… To move from the modern to the postmodern is to embrace skepticism about what our culture stands for and strives for…" (Sim, 2001a, p. vii).

Postmodernism is also poststructuralist in that it rejects the belief that all systems are inherently structured and discoverable (Sim, 2001b, p. 3). In addition, science is often driven by cultural and political motives; the agendas for theoretical and experimental work are determined by people and groups with their own motives and goals (Grant, 2001b, p. 66). Parallel to the postmodern possibility of choosing a lifestyle rather than to conforming to old traditions (Watson, 2001, p. 55), is the idea of choosing a research philosophy and methodology. A variety of legitimate research approaches exist which again reflects the wide variety of products available on the postmodern market. One may also wonder if the stringent requirements by journals for the formatting of papers and articles according to very specific style requirements prior to submission could be a consequence of the postmodern emphasis on style and appearance rather than on content (cf. Watson, 2001, p. 57).

Positivist IS research assumes a single reality and truth, while interpretivist research uses the point of departure of many realities and diverse explanations of the world. Interpretivism has in fact many postmodernist traits. Not only could one look at reality either from a positivistic or interpretive stance, but even within interpretivism there are more than one strand. In addition, it acknowledges that reality is not always concrete and objectifiable, but is very often created by communities. This is true especially of social worlds, but it also often crystallizes into concrete artifacts created by these societies (Klein & Myers, 1999, pp. 68-73). The rest of this section will highlight some of these attributes.

According to Oates (2006, p. 292), interpretive studies try to understand a pluralistic world based on the principle that people assign meanings and values to their unique contexts. It should be noted that Oates herself does not typify interpretivism as postmodern, but the following traits clearly point in this direction. The acceptance of the idea of multiple subjective realities and "dynamic, socially constructed meaning" (e.g. how different IT company cultures experience truth and knowledge and methodologies) is part and parcel of the interpretivist paradigm. Researcher and research participants influence each other during their communication and create understanding, insight and knowledge in the process. The participants are also interpreters and analysts and participate in the creation of facts (Klein & Myers, 1999, pp. 74, 77). Table 2 tries to map some of the postmodern traits onto interpretivist characteristics. It uses the seven principles of interpretive research as identified by Klein & Myers (1999) as its point of departure.

Table 2. Mapping interpretivism on postmodernism (cf. Klein & Myers, 1999; Myers & Klein, 2011; Oates, 2006; Tarnas, 1991; and Easthope, 2001)

Interpretivism	Postmodernism
1. According to the principle of the hermeneutic circle shared meaning emerges in iterative cycles of interpretation. People make sense of emerging social settings and assign meanings to these complex and unfolding realities. Interpretivism provides deep insight into the contexts of organizations. Getting insight and understanding of unique situations and the people issues relating to these is the main goal of interpretivism. Interpretive field studies are 'idiographic', i.e. trying to make sense of unique phenomena.	Knowledge is constructed socially.
2. The principle of contextualization implies that, since societies create their own concrete and social worlds, these should be studied and understood in context. Interpretivism accepts that people create their own physical and social worlds.	The world is open and created by people. Localizing theories replace totalizing theories.
3. The principle of interaction between researchers and participants believes that understanding is an emergent process because researchers and research participants interact and influence each other in a bi-directional way. Therefore, interpretivism tends to use qualitative research approaches.	Postmodernism critiques the "scientific" method (that is, the natural scientific/positivistic method).
4. According to the principle of abstraction and generalization interpretivism attempts to relate unique instances to multiple scenarios. It generates concepts and theories.	Science retains its status due to its rigor and practical applications.
5. The principle of dialogical reasoning implies that researchers have to reflect on their own prejudices since it guides their understanding. However, in some forms of interpretivist IS research, pre-existing theoretical assumptions are not mandatory, e.g. in grounded theory.	Postmodernism has a fluid view of ontology and epistemology; science and technology are not believed to be value-free.
6. The principle of multiple interpretations acknowledges that understanding is not always consensual but that there may be different viewpoints of the same study objects. Meaning and understanding is created by researchers and their participants. Interpretivism accepts that researchers are subjectively involved in the phenomena that they study and that the field of study is pre-interpreted.	Postmodernism accepts a plurality of ethics and lifestyles. It rejects ontological priority and allows alternative understandings.
7. The principle of suspicion guides researchers to look deeper than the surface to identify role players' political agendas.	Postmodernism is skeptic about a solid basis to differentiate between truth and falsehood. It rejects traditional authorities and grand narratives.

The conviction that interpretivism is a typical postmodern research approach does have some serious implications. Since interpretivists believe that individuals or groups construct notions of reality, a typical postmodernist idea, triangulation (comparing the results of different research approaches and methods used to study the same phenomenon) would not always lead to converging results (Oates, 2006, p. 38). When doing group action research in ICT there is a danger of groupthink where the members tacitly create a pseudo-reality in order to prove the validity of their methods and results (Oates, 2006, p. 161). Although the underlying philosophical paradigm of action research may be either positivism, interpretivism or critical research, it has a specific affinity for interpretivism, since it reflects on people in a specific social setting (Oates, 2006, pp. 156, 301). Case studies with its focus on unique situations and multiple interpretations also tend to occur more in the interpretive paradigm (Oates, 2006, pp. 142, 300).

Another IS research strategy that leans heavily towards postmodernism is ethnography. "Ethnographers... examine the 'webs of significance' that people in any culture weave" (Oates, 2006, p. 161). In order to be open for other cultures implies a certain amount of skepticism about the researcher's own (often Western) culture (cf. Oates, 2006, p. 300). In all of these qualititative research approaches – often underlain by interpretivism – taking into account the social context is very important. This is in line with postmodernist traits in other cultural areas, for example art. "[P]

ostmodern buildings and cityscapes are characterized by sensitivity to context" (Watson, 2001, p. 61). A bigger awareness of research participants' communities and values explains the relatively recent upsurge in ethical committees and ethical clearance processes in Social Informatics research.

Software development, too, did not escape the philosophical shift from modernism to postmodernism. According to Brown et al. (2004, pp. 4136, 4141), the move from structured and object oriented approaches to agile approaches allows developers to subjectively create realities because "developers must continually question their assumptions and adopt new ways of thinking". Agile approaches represent a more holistic, relativistic and pluralistic methodology.

It should come as no surprise that design and creation research in IS also tends to be postmodernist. Website audiences are constructions of the developers. IT creates not only information, but also concrete entities. One way to see the web is as a medium that people use to create sets of meanings, communities and practices (Oates, 2006, pp. 145, 146, 180). The web, of course, is built on hypertext. Cotkin (1996, pp. 104, 113) explores the relationships between hypertext, postmodernism and history writing. He suggests that this new technology will change the way in which readers understand text and communicate since it replaces the basic characteristics of text, such as fixedness and linearity, with open-endedness and non-sequentiality. He predicts that hypertext would relativize our concepts about truth by allowing us "to consider a pluralistic universe teaming with options". Atlhough Cotkin does not investigate formal ontologies, one could extend his idea by regarding this related, but more advanced technology, as a way to represent our knowledge regarding subsets of this pluralistic universe. This idea will be discussed in depth in the following section.

From the discussion above it has become clear that postmodernism is deeply embedded in Information Systems practice and research. This reinforces the premise of the chapter that formal ontologies – and the plural form of the word – may be regarded as a typical effect of postmodern trends in IS.

ONTOLOGIES

The IS use of the term ontologies was coined in 1967 by Mealy (Buchholz, 2006, p. 695), and, maybe, this is not by chance only five years after the publication of Kuhn's seminal work, "The structure of scientific revolutions" (Tarnas, 1991, pp. 397, 465), which may be regarded as one of the milestones in postmodern thinking. The author indeed believes that the shift from singular to plural was made possible by the postmodern era that we live in. The question about the origin of the plural form of the word ontology, therefore, necessitated an overview of postmodernism and interpretivism. In this section, formal ontologies, which often are the outcomes of interpretivist research in IS, will be discussed as a postmodernist phenomenon.

Ontology: Exploring the Concept

Ontology has traditionally been (and still is) a philosophical discipline that studies the nature of existence (Yun et al., 2011, p. 57). It has always fitted into a bigger theoretical framework (or meta-narrative), such as rationalism. In a certain time and philosophical era, there usually was, therefore, only one correct or current ontology. In the modernist era, for example, people (including scientists) believed that there was one concrete and common reality outside and independent of human constructs. While ontology is the study of being, epistemology is the theory about understanding and knowledge. Parallel to the ontological belief of a single, concrete reality, positivism with its premise of falsification was regarded as the superior epistemology and other views such as

relativism were suppressed (Firat and Dholakia, 2004/2005, p. 135).

The plural of the word *ontology* did not exist.[2] Academics who were trained in philosophy are often startled when they hear the plural of the word ontology for the first time. Indeed, from a philosophical perspective, ontology is an abstract term. Some philosophers would even regard it as unacceptable to use the plural form (cf. Fonseca, 2007). Yet, in the world of IS, many practitioners use it as one of the most natural things to do.

This section investigates the philosophical move from ontology to ontologies. It tries to answer the question how it happened that the word ontology got a plural and became ontologies. It may even be regarded as an ontology of ontologies, a philosophical discussion regarding the essence of information systems taxonomies which are enriched by description logic.

Although the term ontology has been borrowed by IS from philosophy, it has been given a slightly different meaning. Zúñiga (2001, p. 194) says "the term 'ontology' in information systems circles is distinct from its original philosophical meaning". According to Zúñiga, the essential difference in meaning is due to the interdisciplinary nature of IS. Oates (2006, p. 120) defines ontology as a "set of semantic concepts relevant to a particular domain". Zúñiga (2001, p. 187) defines an information systems ontology as a "formal language designed to represent a particular domain of knowledge". "Ontologies are used to capture knowledge about some domain of interest. An ontology describes the concepts in the domain and also the relationships that hold between those concepts" (Horridge, 2009, p. 10). In this chapter, IS ontology and formal ontology are used as synonyms. While the singular term refers to a comprehensive conceptual set of terms representing one, specific domain, the plural refers to conceptual sets of different domains (Chandrasekaran et al., 1999, p. 21).

A formal ontology may be regarded as a taxonomy with added consistency and reliability. While a thesaurus is a plain list of related concepts, and a taxonomy is an enhanced form that highlights the relations between the concepts, a formal ontology adds reliability to the mixture. Adding description logics makes the system computer-processable and enables it to reason about its own consistency (Gilchrist, 2003, pp. 7, 10, 13; Lambe, 2007, p. 6). A formal ontology consists of individuals, properties and classes. Individuals identify specific instances of entities, a class (also called a concept) is a set of individuals, and properties describe the relations between two individuals, linking them together. Taxonomies that are bootstrapped into ontologies contain a hierarchy of super-classes and subclasses. The built-in reasoner of an ontology web language (such as Protégé 4) can compile these subsumption relationships automatically (Horridge, 2009, pp. 9-12).

The dual role of the word ontology is described excellently in a call for papers for FOIS2010:

Ontology began life in ancient times as a fundamental part of philosophical enquiry concerned with the analysis and categorisation of what exists. In recent years, the subject has taken a practical turn with the advent of complex computerised information systems which are reliant on robust and coherent representations of their subject matter. The systematisation and elaboration of such representations and their associated reasoning techniques constitute the modern discipline of formal ontology, which is now being applied to such diverse domains as artificial intelligence, computational linguistics, bioinformatics, GIS, knowledge engineering, information retrieval, and the Semantic Web. Researchers in all these areas are becoming increasingly aware of the need for serious engagement with ontology, understood as a general theory of the types of entities and relations making up their respective domains of enquiry, to provide a solid foundation for their work (International Association for Ontology and its Applications, 2009).

IS ontologies facilitate the building of knowledge representations and the sharing of these bodies of understanding. "An ontology can represent beliefs, goals, hypotheses, and predictions about a domain, in addition to simple facts" (Chandrasekaran et al., 1999, pp. 21-22). However, ontologies are not objective representations of reality. Creating them requires analysis of a subset of reality and reaching consensus between the role players on what aspects are chosen and how they are grouped and related. Therefore, there are often different ontologies that reflect the same general concepts. Ontologies are used, for example, in artificial intelligence to facilitate natural language understanding and knowledge-based problem solving (Chandrasekaran et al., 1999). Linguistic ontologies are used to enhance web searches (Guarino et al., 1999). In engineering, ontologies are used to create shared frameworks to overcome the lack of consensus regarding key concepts which exists due to different disciplinary backgrounds (Borgo et al., 2009). Since different technologies and approaches are used to represent knowledge, upper ontologies are used to integrate divergent domain ontologies, but integration remains one of the main challenges for the field (Schlenoff & Uschold, 2004).

However, one could not go so far as to say that the two uses of the word have become homonyms. They are still historically and logically related. The relationship between the two uses is founded in the cornerstone of classification. The work done by philosophers in trying to make sense of reality by means of classification forms the basis of ICT ontologies, which may be regarded as practical applications of these philosophical endeavours (Buchholz, 2006, p. 694).

Information Systems theory uses the concept of ontology in another, more philosophical sense, namely regional or fundamental ontologies. In this sense the concept of ontology refers to the essence of a phenomenological domain (Sewchurran et al., 2010). An in-depth discussion of its use to explicitly locate research within a philosophical ontology falls outside the scope of this chapter.

One could only hope that informaticians and philosophers will explore the interrelationships of their disciplines by building on the connections revealed by ontology and ontologies. Zúñiga (2001, pp. 187, 189) indeed says that ontology "has served as the bridge for the coming together of information systems and philosophy" and pleads for the integration of insights from philosophical ontology into IS ontologies. Hence, the next sections is an attempt to understand the philosophical, postmodernist drift that underpins the pluralisation of the ontology concept in IS.

Formal Ontologies as the Epitome of Postmodernist, Interpretivist Research Outcomes in IS

Despite the relativity of knowledge and the fluidity of understanding and wisdom in the postmodern era, scientists do not have to feel that their work is without value. It has retained its status due to its rigour and practical applications, and in fact, it has been enabled to be more creative and less restricted (Tarnas, 1991, p. 404). The validity and quality of interpretivist research may be judged against its own set of criteria, such as confirmability and plausibility (Oates, 2006, pp. 294-295).

Scientists and practitioners can choose an ontology that reflects their viewpoints and practical needs the best, and they may even adapt or build a new one, thus participating in the creation of a new reality (cf. Tarnas, 1991, p. 406). The design and implementation of a formal ontology in an information system may indeed be regarded as the construction of a reality. Formal ontologies are the concrete representations of "little narratives", i.e. fleeting realities created for specific objectives (Sim, 2001b, p. 7). They declare subsets of reality as entities and describe the relations between them in a machine programmable way.

Although it aims to reflect the tacit knowledge regarding a business or social aspect, it also freezes

that knowledge and forces users to accept this version as truthful and authoritative. It is typical design and creation research because it generates a type of vocabulary or set of concepts used in a specific ICT scenario, a type of construct regarded as an IT artefact (Oates, 2006, p. 108). Oates (2006, p. 120) also refers to the creation and instantiation of an ontology in website research as a new construct. Creating an ontology does not only require technical skills, but also analytical abilities and philosophical wisdom, and, therefore, also contributes to academic knowledge, while at the same time being traceable, confirmable and based on solid theory (cf. Oates, 2006, pp. 109-110, 294-295). On the other hand, formal ontologies are also used to check/test the logical consistency of the theoretical paradigms on which they are built (Fonseca and Martin, 2007, p. 137). Formal ontologies are used in the semantic web to allow "software agents to understand, share and reason about data" (Ferdinand, Zirpins & Trastour, 2004, p. 354). This is made possible by the ontology web languages into which artificial intelligence and description logics are built to facilitate the incorporation of inference rules and axioms in the taxonomies.

Since each ontology can only be an attempt to represent knowledge of a certain subset of reality, it seems to be an unattainable goal to strive for one single overall ontology that spans the whole world. "In information science, an ontology refers to an engineering artifact, constituted by a specific vocabulary used to describe a certain reality" (Fonseca, 2007).

The divergent multiplicity of ontologies in IS itself can also be understood in the context of multiple realities that is so typical of postmodernism. An ontology may be regarded as a representation of the human knowledge of a specific group of people regarding a specific subject area, which is provisional and transitory because "[h]uman knowledge is the historically contingent product of linguistic and social practices of particular local communities of interpreters, with no assured 'ever-closer' relation to an independent a-historical reality" (Tarnas, 1991, p. 399). Indeed, one may also regard the creation of IS ontologies in a positive way as the endeavours of academics to embrace the multifaceted nature of reality by representing subsets of it by means of more meaningful vocabularies and taxonomies (cf. Tarnas, 1991, p. 407).

Formal ontologies may, therefore, be regarded as a venture into postmodern analysis that acknowledges "the potential of local systems solutions" and the importance to accept "as valid a range of methodologies" (Harrison, 2004, pp. 165-166). A single (philosophical) ontology is replaced by a plurality of (formal) ontologies that reflect partial and fragmented sets of knowledge. The plural concept of ontologies, used in ICT, reflect the idea of multiple realities that is so typical of postmodernism. While IS ontologies may be regarded as one way of describing the objective/material world, the plurality of ontologies is simultaneously a witness of different embodiments of truth. It should be combined and synthesized with other methodologies to provide a holistic understanding.

Although the multiplicity of ontologies being created and used in IS mirror "the most significant characteristics of the larger postmodern intellectual situation – its pluralism, complexity, and ambiguity" (Tarnas, 1991, p. 402), this status quo may be regarded as a melting-pot of ideas that may eventually give birth to a "fundamentally new form of intellectual vision, one that might both preserve and transcend the current state of extraordinary differentiation" (Tarnas, 1991, p. 402).

An attempt to integrate various systems is an endeavour towards a synthesis of mental perceptions (Tarnas, 1991, p. 397). When one is confronted with various ontologies addressing the same subject area, one is actually dealing with the typical postmodern condition in which "[a] chaos of valuable but seemingly incompatible interpretations prevails, with no resolution in sight", but

which also creates new challenges for scientists to clarify and reconcile (Tarnas, 1991, p. 409).

It is inevitable that scholars build their subjective perspectives into the software that they create; their theoretical paradigms become ingrained in the structuring and analysis of the data (Rechenmacher & Van Der Merwe, 2005, pp. 77-78; Buchholz, 2006, pp. 694-695). According to Tummarello et al. (2008, p. 468), "[a]greeing on an encoding scheme is an obvious step for interoperability...". For example, the creation of an ontology of Biblical Hebrew (BH) syntax could be an undertaking that stimulates a debate among BH grammarians to integrate various existing systems in use (Kroeze, 2009). The integration of ontologies by super (top-level) ontologies may be an attempt to reconcile deconstructed world views – deconstruction and integration are two opposite trends complementing each other (Tarnas, 1991, p. 407).

Many aspects of research on formal ontologies may also be regarded as postmodern. Since IS ontologies are cultural products, an interpretivist approach is more suitable than a positivist approach for critical analysis and research regarding them (Oates, 2006, p. 292). Above, intrepretivism has been characterised as typically postmodern.

As was suggested by the premise of the chapter, it may be concluded from the discussion above that formal ontologies are quintessential examples of postmodern deposits in ICT. Some implications of this close relationship, however, still need to be pointed out.

IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

There are some interesting paradoxes regarding the postmodern cultural state. For example, globalization stimulates a reappearance of nationalism, and wider choices for consumers created new, quite traditional mega-companies (Conlon, 2000, p. 111). Another paradox is that ICT, which is regarded as modernist technology, is now called on to undergo a paradigm shift itself and become, via emotional digitization, postmodernist in essence (Hohmann, 2007, p. 24). The finding that ICT can both be regarded as an agent and as a result of postmodernism is also rather ironic, but understandable since postmodernism is to be regarded as the continuance of modernism and does not necessarily stand in direct opposition to it. It may be the effect of the cyclical succession of modernisms and postmodernisms, and of the deconstruction and reconstruction of grand narratives (Sim, 2001b, p. 14).

Formal ontologies reflect the typical postmodernist characteristic of both multiple truths and an attempt to integrate these. They have a dual nature since they are social constructions that may reflect divergent views or develop as disciplines evolve, while they simultaneously represent the fixed result of shared understanding and definition of the scientific vocabularies (Sicilia, 2006, p. 85). In order to create a useful ontology, some level of standardization has to be agreed upon (Sicilia, 2006, p. 83). Or in the words of Murphy (1988, p. 180), "order represents a social contract, as persons learn to read the world in a similar manner". Ontology web languages facilitate the creation of a plethora of formal ontologies, which reflects the pluralistic universe. It is, therefore, rather ironic that there is an attempt within individual formal ontologies to be very modernist by trying to incorporate strict rules by means of formal logic that describe the relationships between the entities. This seems to go against the fluidity that is typical within postmodern structures.

Besides the paradoxes of the quadruple ICT-ontologies-interpretivisim-postmodernism relationship, one also has to reflect on possible dangers regarding the hyper-reality of ontology-driven software. In a wider context, Matusitz (2008) explores ICTs as tools used by cyber-terrorists to create a chaotic scenario, which he believes is typical of the postmodern age. More relevant for the topic of this chapter is the risk that formal

ontologies could become more real than reality, although they are meant to mirror and capture a slice of it (cf. Matusitz, 2008, p. 180). It is typical of postmodernism that real life phenomena are replaced by representations (simulacra) (Siraj and Ullah, 2007, p. 3). Simulations and hyper-reality developed from direct representations of the real word through an intermediate phase of emancipation into independent signs (cf. Watson's 2001, pp. 59-60 discussion of the history of simulacra). Simulacra now replace the realities that they represent resulting in a situation where people are not able to differentiate between them (Sim, 2001b, p. 11). In the twenty-first century simulacra very often are electronic simulations. Edutainment, for example, presents products in advertisements in the cloak of rigid research results. The pretention is made all that more feasible by pseudo-scientific, computer-aided graphs and statistics. Artificial intelligence is another good example of electronic simulation. The Turing test is, like postmodern science in general, more interested in signs and simulations than in reality itself. A machine or program may be regarded as intelligent if it is impossible to differentiate between a human's real intelligence and the computerized simulation thereof (Grant, 2001b, pp. 66, 73).

An implemented ontology may eventually become a technological tyrant if it enforces a new or attenuated reality on the enterprise. Such a tyranny of ontology could become a new cause of anxiety, which is similar to the phenomenon that people may feel like victims of information due to information overload and information pollution (cf. Siraj and Ullah, 2007, p. 9).

An ontology that locks people into a language system may in fact undermine human agency or free will. Rychlak (1999, p. 385) believes that traditional computer models, which are built on binary logic using Boolean algebra, cannot simulate human agency because they cannot think laterally like humans do. However, the open-world assumption of formal ontologies (the declaration of an individual entity as a member of a specific class does not imply that it cannot also be a member of another class) and the possibility to define attributes of classes and to create relationships between them (Horridge, 2009, pp. 9-12) may pave the way to a more human-type of reasoning in computing. This implies that formal ontologies also provide opportunities to free enterprises from digital despotism. Rychlak (1999, p. 388) indeed sees possibilities for the modeling of human agency in postmodernism since the postmodern outlook sustains oppositionality (the ability to link semantically related concepts), which he believes is the essence of human thinking or dialectical reasoning. If the proposition of this chapter is correct, i.e. that ontologies are a typical postmodern phenomenon, it could, therefore, substantiate the idea that formal ontologies simulate human thinking in a more natural way.

A further opportunity rendered by postmodernist technology is the integration of human-oriented qualities such as emotion and aesthetics, which would differentiate it from modernistic technologies that are experienced as cold, precise and rationalistic. Postmodernism pluralises culture and humanises technology (Hohmann, 2007, pp. 18-19). A typical trait of postmodernism is "the change from a technology that replaces people to a technology that supports people" (Hohmann, 2007, p. 19). Formal ontologies may be another way to humanize and pluralize technology. Yet, more research is needed on how formal ontologies could be used to incorporate aesthetics and emotion in software.

The postmodernization of ICT may also indicate a positive turn in the creation of bodies of knowledge. In the eighties of the previous century computerization was still seen as technology that would bring modernism to fulfilment due to its rationalistic and quantitative tendencies which would make information and knowledge contextless (Murphy, 1988, pp. 175-176). Viewed from this perspective the creation of an ontology may be regarded as an endeavour that produces the illusion of a knowledge system. "Stress is placed

on massaging data and exploring their interconnections, until events are classified correctly. Once this taxonomic exercise is completed, a system of knowledge is thought to be available" (Murphy, 1988, p. 178). Ironically, ICT became an agent of postmodernism, and text-based computer languages, like HTML and XML, changed the modernistic, binary character of computing because it facilitates the incorporation of context by means of hyper-linking networks of data and knowledge.

Educational systems are also influenced by postmodernism and its changing concepts of knowledge and wisdom. According to Conlon (2000, p. 113), ICT promotes a de-schooled society, which is one of the visions of libertarianism (a postmodern view of education, the counterpart of a paternalistic vision of education). If one accepts the finding that formal ontologies reflect divergent world views, endeavours to design and select an educational taxonomy that resonates with a culture's belief systems should be regarded as a step in the direction towards a more balanced vision of paternalistic and libertarian approaches (cf. Conlon, 2000, pp. 114, 116).

A final remark pertains to the co-evolution of humans and machines. Mazlish (1993) regards this process as overcoming "the fourth discontinuity". The first discontinuity was broken when Copernicus indicated that the earth (and people) is not in the centre of the universe. The second mental barrier was crossed when Darwin showed that people are part and parcel of evolved life. Freud bridged the third discontinuity by linking humans' consciousness and sub-consciousness. In the current culture of the computer-brain revolution the difference between human and machine reasoning has become blurred (Mazlish, 1993, pp. 178-198), and formal ontologies will blur the boundaries between technology and concrete reality even further, thus facilitating the convergence even further. Since no technology is neutral, this merging of man and machine will probably have both positive and negative impacts on humanity. One may express the wish that the incorporation of formal ontologies will humanize the products of these unions. Indeed, "technology without philosophy is blind. Unless it is harnessed to a clear vision of change then chip by chip, the technology could take us into a future that we would never willingly have chosen for ourselves" (Conlon, 2000, p. 116).

Limitations and Future Work

Since postmodernism is not directly addressed in most IS literature, many logical deductions had to be made in order to characterize interpretivism as a postmodernist research theory. Since it would be impossible to test these premises empirically, the ideas should be scrutinized by IS philosophers, well versed in philosophical theory, to judge the credibility of the reflection. No doubt a lot more could have been said, either for or against these arguments, and the author hopes to have stimulated some debate. The time has come in IS research to take note of the postmodernist era and to reflect on its consequences for the discipline. Another area which has only been touched upon, pertains to the quality assurance of interpretivist research (cf. Oates, 2006, pp. 294-295; Klein & Myers, 1999, p. 68). Grounded theory, surveys and triangulation are more IS research concepts that have not been covered in depth (see Oates, 2006, pp. 38, 93, 276, 300).

In future research, the limitations mentioned above, should be addressed. Since critical research shares a lot of interpretivism's points of departure, an in-depth study is also needed to map postmodernist traits onto the characteristics of this anti-authoritarian research philosophy that is becoming more popular in IS (cf. Oates, 2006, pp. 293-298 and Sim, 2001b, p. 7). A recent article proposing a set of principles for IS critical research may be a good starting point towards a comparison of this epistemology with postmodernism (Myers & Klein, 2011). Since the philosophy of science is the point of departure of this article,

it refers exclusively to IS literature. Future work should move away from this self-referencing approach and enter into a discussion with general philosophers in order to test these ideas in the wider philosophy.

CONCLUSION

The chapter investigated the move from philosophical ontology to information systems ontologies, referring to the computer-based representation of subsets of reality and knowledge. After a discussion of basic concepts needed for the argument the idea was explored and confirmed that a postmodernist view of reality prompted the pluralization of the abstract concept of the study of being, a cultural shift that was accelerated by ICT. This conceptual development is expressed *par excellence* in interpretivist IS research and formal ontologies that both reflect and integrate multiple realities. Although the aim of a single formal ontology may be quite modernistic, since it is an attempt to formalize the terminology and attributes of a certain field, the proliferation of ontologies, often to describe the same subcultures, may paradoxically bring various beliefs and understandings to the surface. Despite some perils, the marriage of ontology and information systems also creates interesting opportunities to humanize technology. Interpretivist research approaches will often be the vehicles used to facilitate this process.

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KEY TERMS AND DEFINITIONS

Epistemology: A theory which makes explicit the underlying assumptions about understanding and knowledge.

Formal Ontology: A taxonomy of a subset of reality, which defines the relationships between the entities and ensures consistency and reliability by means of description logics.

Interpretivism: An epistemology that focuses on reality as a human construction which can only be understood subjectively.

Ontology: A theory which makes explicit the underlying assumptions about reality and the nature of existence.

Paradigm: A paradigm refers to a set of theories which is typical of a historical phase in the philosophy of science.

Positivism: An epistemology that focuses on reality as a concrete given entity which can be understood objectively.

Postmodernism: An encompassing paradigm, referring to a set of assumptions regarding ontology (realities are created), epistemology (knowledge is fluid and provisional), methodology (interpretive and critical methods are more apt to study a plural society) and axiology (the study of values: no one set of values are per definition better than another).

Qualitative Research: A research approach that aims to understand patterns and to answer how and why questions.

Quantitative Research: A research approach that aims to identify patterns by means of numerical and statistical means.

ENDNOTES

1 This chapter is a revised and extended version of the following conference paper: Kroeze, J. H. (2010). Ontology goes postmodern in ICT. In *Fountains of Computing Research* – Proceedings of SAICSIT 2010 (Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists), 11 to 13 October 2010, Bela Bela, South Africa, edited by Paula Kotzé, Aurona Gerber, Alta van der Merwe and Nicola Bidwell, CSIR Meraka Institute, A Volume in the ACM International Conference Proceedings Series, ACM Press, ACM ISBN: 978-1-60558-950-3, pp. 153-159. Available: http://portal.acm.org/.

2 This explains the fact that the plural form, *ontologies*, is not even recognized by the spell checker of a word processor such as MS Word.