A Platform for a Pragmatic Metatheoretic Model for Information Systems Practice and Research

Roger Clarke
Xamax Consultancy Pty Ltd, Canberra,
Research School of Computer Science,
Australian National University, and UNSW Law, Sydney
Email: Roger.Clarke@xamax.com.au

Abstract

This work is motivated by the need for a firm foundation for analyses in support of a number of contemporary challenges facing the information systems (IS) profession and discipline in such areas as the management of digital identity and of data quality.

This paper reviews alternative approaches to the three key components of metatheory that underlie theories and practices in the IS field: ontology, epistemology and the relatively new field of axiology, which is concerned with the notion of value. Mainstream assumptions about the researcher as an independent, value-free observer of phenomena are being undermined by recognition that researchers adopt one or more perspectives, most commonly of a single stakeholder, that the inherent bias in most research is towards the particular value-sets of the favoured stakeholders, and that this needs to be acknowledged, reflected and allowed for when drawing inferences from reported research.

In order to support the categories of research that are the motivation for the present work, a pragmatic metatheoretic model is proposed, which approximates and articulates a layman's 'common sense' interpretation. It comprises a working set of assumptions in each of the areas of ontology, epistemology and axiology. The model is relevant to IS practice, and to that portion of IS research activity that is intended to be relevant to IS practice.

Keywords Ontology, epistemology, axiology, value, stakeholders

1. Introduction

This paper's purpose is to establish a metatheoretic platform for a model intended to support particular areas of information systems (IS) practice and research. A key focal-point is the representation of natural objects, artefacts and animals within IS, and particularly the representation of humans. The involvement of people within systems raises many issues additional to those arising with inanimate objects and subjugated species. The model also has application to active artefacts, that is to say manufactured items that act in the real world. The paper presents foundational material usefully referred to as 'metatheoretic', enabling the model to be grounded in existing theory relating to ontology, epistemology and axiology. Because of the complexities within each of those fields, care is needed to identify appropriate selection criteria and achieve sufficient comprehensiveness.

The project is instrumentalist in nature. In contrast with the 'pure research' motivation of 'I want to discover and understand what is', and the 'applied research' orientation of 'I have a research tool, so I will use it', an instrumentalist mindset is 'There is a problem, so I will solve it'. The project's purpose is to assist in understanding phenomena, in associating data with appropriate identities and entities, and in dealing with the sensitivities involved where the data involved is about human beings. The selection criteria for a metatheoretic model are accordingly pragmatic in the sense in which that term is used in philosophy, that is to say it is concerned with understanding and action, rather than merely with describing and representing. The aim of the model being developed is to speak to IS practitioners, and to those IS academics who intend the results of their research to do the same.

The paper commences by outlining the notion of metatheory as it is used in this work, and summarising the three branches of philosophy most relevant to the discussion. The three subsequent sections consider what the IS literature has to say about, in turn, the ontology, epistemology and axiology underlying IS research and practice. The final section of the paper outlines how the pragmatic metatheoretic model will be articulated and applied in subsequent papers.

2. Three Relevant Branches of Philosophy

Researchers and practitioners alike unavoidably make **'metatheoretic assumptions'**, often implicitly, and sometimes consciously. Where the assumption is not merely conscious, but is also intentional, the term **'metatheoretic commitments'** is appropriate. The purpose of this section is to provide a basis for the analysis of discussions in the IS literature about the metatheoretic assumptions and commitments underlying IS practice and practice-relevant IS research.

In order to talk about them, it is necessary to draw on relevant branches of philosophy that establish **'metatheory'**. The three branches of philosophy discussed here are ontology (concerned with existence), epistemology (concerned with knowledge) and axiology (concerned with value). A fourth metatheoretic aspect, methodology (concerned with processes), is in part derivative from the other three, and in part dependent on context, and hence is only treated in this work in passing. Some other branches, such as semantics and linguistics, are not directly addressed in the current work.

This section is intended as a short summary of the general nature of the three relevant branches of philosophy. It reports widely-known information drawn to a large extent from 'textbook' expositions rather than research publications, and is accordingly not supported by citations.

2.1 Ontology

Ontology is the study of what exists (literally, the meta-science or study of being). Conventionally, that which exists is referred to as **'things'** and **'events'**, and collectively as **'phenomena'**.

The many theories that have been put forward are conventionally distinguished as falling into one of two groups:

- 'Materialism', which holds that matter is what exists, and it is independent of the presence or otherwise of human detection of that matter; and
- 'Idealism', which says that everything exists in the human mind, and that the 'real world' that we think we see is only a shared idea.

Much of the activity within the field of ontology devolves into alternative approaches to how to define **'categories'** of that which exists. A pattern whereby categorisation can be performed is referred to as a **'taxonomy'**. Taxonomies are often devised such that the elements (called 'taxa', singular 'taxon') are organised into some form of hierarchy.

The act of categorisation necessarily involves the postulation of **'properties'** (or features or characteristics) of things that provide a basis for allocating them into particular groups. All aspects of such analyses are likely to be heavily contested when the domain under discussion is abstract ideas, but the appropriate qualities to attribute to even apparently concrete objects can turn out to be far less easily agreed than might be expected: notions such as colour, robustness and intended function of an artefact come in many flavours.

A conventional compromise between materialist and idealist notions in ontology is the dualism postulate: that there are both material realities (the Real-World) and internal 'mind-stuff' (the spiritual, intellectual or Abstract-World). Phenomena and their properties (such as the wavelength of electromagnetic radiation, hardness and brittleness of things, and event-duration) inhabit the Real-World; whereas ideas (such as numbers, colours, hardness, brittleness and time, and lists of the intended functions of artefacts) are of the Abstract-World.

2.2 Epistemology

Epistemology is the study of knowledge, and its sources, varieties and limits. Again, most theories tend to be categorised into a couple of competing views:

- **'Empiricism'** holds that knowledge is derived from sensory experience. The strong form of empiricism, referred to as **'positivism'**, together with its more recent form of **'logical positivism'**, holds that nothing is innate, and that only that which can be observed and/or measured merits consideration. The term **'scientism'** refers to the extreme positivist position, proposing that science is not only better than other approaches to knowledge, but the only valid, justifiable or useful approach; and
- **'Apriorism' or 'Rationalism'**, on the other hand, considers that knowledge can be innate and/or derived from the human faculty of reason. An extreme position denies the possibility of knowledge existing outside the individual mind.

The search for a truce between the two perspectives results in a widely-held assumption that knowledge depends on appropriately blending sensory experience and reasoning. Another pragmatic compromise is the recognition of two (very different) notions, both of which are (qualified forms of) the idea of knowledge:

- **'codified knowledge'**, which refers to data expressed and recorded in a more or less formal language (possibly just text, but preferably using a defined dialect or terminology, procedure descriptions, formulae, blueprints), that is disembodied from individuals, but communicable among them, and hence capable of delivering a coherent body of information to individuals in particular contexts. This reflects the empiricist and particularly the positivist view of epistemology; and
- **'tacit knowledge'**, which exists only in the mind and/or body of a particular person, is informal and intangible, and hence is not readily communicated to others. This reflects the apriorist view of epistemology.

An omelette recipe is codified knowledge; whereas the expertise to interpret the recipe, to apply known techniques and tools to the activity, to recognise omissions and exceptions, to deliver a superb omelette every time, to sense which variants will work and which won't, and to deliver with style, are all tacit knowledge.

Tacit knowledge has to do with familiarity, awareness, or understanding of something . Distinctions are drawn among:

- **acquaintance knowledge**, "having sensory experience of", concerned with objects;
- **procedural knowledge**, "knowing how to", concerned with skills; and
- **propositional knowledge**, "knowing that", concerned with assertions.

A longstanding school of thought is that propositional knowledge is equivalent to a justified belief that an assertion is true. On the other hand, there is dispute as to:

- whether or not knowledge has to be in accordance with the relevant domain, i.e. whether the proposition has to be in some sense true, and, if so, how stringent the criteria for **'truth'** should be; and
- whether:
  - knowledge necessarily implies belief in the truth of that which is known (which blends and confuses the logical and the spiritual); or
  - a reasonable presumption of 'truth' is sufficient (e.g. support by a body of evidence); or
  - a working assumption is sufficient (a postulate, or a contingent, situational assertion).

Some propositions are *ad hoc* conjectures. The term **'theory'** is applied to a coherent group of propositions that together are postulated to represent a systematic description of phenomena within a particular domain (possibly also supporting explanation and even prediction). In an ideal form, a theory is founded on express, foundational assertions of a general nature, referred to as **'axioms'**, which can be processed using formal rules of logic, in order to produce inferences. Applying those rules iteratively to axioms and intermediate inferences, gives rise to more specific inferences, which are operationally defined, i.e. they can be related to phenomena in the real world.

A **'scientific theory'**, at least in the Popperian tradition, is one that enables inferences to be drawn that are in principle 'refutable' by comparison against observations of the real world. Matters of belief in religion and politics are not refutable, e.g. 'through grace, a believer's soul is saved', 'only a virtuous ruler can survive'. A scientific theory has the benefit of naturally leading to disciplined observation and experimentation, such that discoveries are cumulative.

2.3 Axiology

Axiology, a term coined early in the 20th century, is a branch of philosophy concerned with the nature and classification of **value** and how value is imputed to things. The ethicist approach considers value on what might be called a **'virtue'** dimension of 'good / bad'. Arguments also exist for a **'deontic'** approach, i.e. related to duty or obligation, on a 'mandated / optional / forbidden' dimension.

'Intrinsic value' implies the thing or its properties are valued in themselves or for their own sake; whereas 'extrinsic value' arises because the thing or its properties are a means to something else, such as the function it performs, the outcomes of the performance of that function, or its relationship with other things.

Value is generally relative, situational or contingent. One important contextual factor is whether the perspective adopted is that of an individual or a collective. Value may be comparative, as in the Ancient Greek idea of the sphere being valued more highly than the square, the square than the rectangle, and the male than the female. This has been argued to be extensible to a **hierarchy of value-categories**, from higher to lower:

- sacredness (holy/unholy)
- spirituality (truth, beauty, vs. their opposites)
- nobility/vulgarity
- pleasure/pain
- utility/uselessness

The term **'utility'** is concerned with impacts or outcomes. The notion of **'teleology'** has to do with purpose, and **'consequentialism'** with the proposition that an action must be evaluated on the basis of its impacts or outcomes in relation to purpose.

Particular approaches to epistemology tend to be associated with particular approaches to ontology. Similarly, axiology can be mapped against epistemology. Positivist epistemology postulates that humans can make judgements and undertake activities in a value-free manner. It has, however, come to depend on the notion that values that are incommensurate can be somehow reduced to a common denominator, by means of what is commonly referred to as a 'utility function'. Antipositivist forms of epistemology criticise that view as 'comparing apples and oranges', and assert that all judgements and activities are value-laden. An interpretivist approach recognises that there may be considerable differences among the values of different observers of the same phenomena.

3. Ontology in the IS literature

The IS discipline is concerned with data and information, and their handling by humans and artefacts. Although synthetic data (such as test-data) is used in IS, the large majority of the data handled is empirical, that is to say it is asserted, or at least assumed, to reflect real-world phenomena. Ontology is the study of that which (in some sense) is. Hence work in the IS discipline and in the IS profession depends on ontological assumptions – whether or not those assumptions are expressed, and whether or not the academic or practitioner is even aware that they are making those assumptions.

In Iivari et al. (1998), common assumptions of IS academics are proposed in the areas of "ontology (what is assumed to be the nature of IS)" and "epistemology (what is human knowledge and how it can be acquired)": "We propose that the ontology of IS research is concerned with the following phenomena: information and data, information systems, human beings in their different roles of IS development and IS use, technology, and human organizations and society at large" (p.172).

The ontological model most often cited in IS is commonly referred to as **the Bunge-Wand-Weber (BWW) model**. It has been the subject of a long series of publications, commencing with Wand & Weber (1988). BWW offers a definition of "information systems as abstract objects, independent of their use and implementation technology" (p.223). Wand & Weber (1990) proposes an ontological model "to define a set of constructs that are necessary and sufficient to describe the structure and behavior of the real world" (p.63), and uses it as a means of identifying shortfalls in the completeness of the entity-relationship model (ERM) of Chen (1976).

Wand et al. (1995) applied the approach to ontology of Bunge (1977, 1979), combined with concept theory and speech act theory, to decide what constructs should be included in a conceptual modelling language for information systems within organisational environments. A lengthy monograph (Weber 1997) provides an exposition of BWW: "The world is made up of things. We know about things in the world via their properties. All things have properties ... [O]ur models ... ascribe attributes to things to represent the properties of things that we believe they possess" (p.34). The notion of 'things' is later extended to 'events', and to the generic 'phenomena'. "We understand the world through our models" (p.35), and "we can ... model a thing in different ways, simply by choosing to focus on different properties of the thing" (p.38). "[Data] is a representation of some phenomenon in the real world - for example, a thing, or the properties of a thing, or the state of a thing, or an event. ... Information must have novelty value. ... the age-old distinction that is often made between data and information: Data has value when it is useful in some way to a decision maker" (p.59). I have substituted 'data' for 'information' at the beginning of the quotation, in order to more appropriately reflect the content. I also suggest a re-phrasing of the final sentence to somewhat broaden the means whereby value arises: 'Information is data that has value by being useful in some way'.

Further, "Information systems ... are ... used to represent or to mirror or to simulate phenomena in the real world" (p.65). "The essence of [data] processing is that representations of things are being changed to reflect that these things have undergone some type of state change" (p.66). "We depend upon the fidelity of this changing representation for the effectiveness of the actions we then take in the world ... We have become [dependent] upon the authenticity, accuracy, and completeness of the representations now contained within many information systems" (p.67).

A critical review of the BWW model is offered by Wyssusek (2006). It notes Bunge's adoption of a materialist approach to ontology and an empiricist approach to epistemology, in both cases towards the 'hard' end of the range, i.e. tending to deny idealism and *a priori* or innateness notions. Bunge's proposals are argued to be heavily formalised, "imbued with abstractions and formal logic" (p.69), and the attitude to alternative approaches as one of intolerance. The author notes that the intention of the BWW model is to provide a way of representing humans' perceptions of their worlds. Their effort has to do with "the quality of the mapping between information system users' conceptualisations of the real world and the representations of these conceptualisations in the information system" (p.70), as distinct from the quality of the mapping between the 'real world' and users' conceptualisations of the real world. He argues that there are inconsistencies between key features of Bunge's approach and the Wand and Weber application of it (pp.70-73). Wyssusek's criticisms of BWW elicited a defence, in Opdahl (2006).

In Riemer et al. (2013), the critique is pursued further. The authors remark that " ... knowledge elicitation and representation are frequently taken as unproblematic due to deep and largely unexamined ontological and epistemological commitments held within the field. ... We question the ontological grounding of [organisational modelling, in particular process modelling] in a cognitivist and dualist [Cartesian] worldview. We subsequently present an alternative ontological and epistemological foundation drawn from the work of German philosopher Martin Heidegger (1927; 1962)" (p.2). The authors argue that "1) people are unable to easily and completely articulate everyday, routine practices as they are grounded in tacit and embodied knowledge, 2) that expertise cannot be fully expressed and captured as a set of rules, that 3) routine work is heavily situated in a material and social environment which cannot be authentically captured by abstract symbolic representations" (p.2).

The authors depict the Cartesian worldview as dualist, in that it "stresses the distinction between the external and the internal world, ... [and] places human subjects vis-a-vis an 'external' world that is made up of objects with properties ... [such that] humans ... take in this external world via our bodily senses and hold in our mind an internal representation of the (objects in the) outside world ... Hence, the Cartesian view posits a mind 'in here' reflecting on, and directing the body to act upon, a world 'out there'" (p.5). The Cartesian worldview is contrasted against the holistic approach of Heidegger.

Rather than a focus on "the kinds of entities there are in the world", Heidegger asks: "what are the kinds of ways that entities can be in the world?" (p.6).

"For Heidegger the way of being of humans (Dasein) is engagement in practices. The unique mode of (human) existence is to be such-and-such by doing such-and-such" (p.6). "A word processor is not seen as a software artifact with a set of features, but encountered practically as a 'to-write-letters', 'to-capture-ideas', 'to-edit-a-memo'" (p.7). Further, "it is only through our (tacit) experience of equipment ready-to-hand in practical activity that objects and their properties can be intelligible to us at all" (p.7). "[Rather than] the dualism between knowing and being, ... the being of entities is grounded in our practical understanding of, and familiarity with, the world of which we are an integral part" (p.8). In effect, this approach to ontology leads to an emphasis in epistemological terms on 'tacit knowledge' rather than 'codified knowledge', and 'know-how' rather than 'know-that'. It also reflects the conventional view that the structure and processes of human perceptual and cognitive apparatus are very different from those assumed by formal models.

Seen through this lens, the presumption that process modelling is an objective activity is undermined, and it is instead "a practice that aims to create specific simplifications of organizational reality for specific purposes by specific stakeholders" (p.12). Put another way, a model reflects the perspective(s) adopted by the modeller, and can have varying degrees of correspondence with particular stakeholders' views (and varying degrees of usefulness), but it cannot be 'right' or 'true'.

Wand & Weber (2017), reviewing 30 years of the BWW model, acknowledged the Riemer et al. (2013) critique. However, they drew on the argument of Opdahl (2006) that "ontological models for conceptual modelling should primarily be evaluated according to how well they inform conceptual modelling practice and research" (p.102), concluding that "philosophical debates are best left to trained philosophers and that information systems scholars should focus instead on the pragmatic consequences of different philosophical positions" (Wand & Weber 2017, p.7).

In Lukyanenko et al. (2021), an examination is conducted of the extent to which Bunge's "later and broader works" (p.1), characterised by those authors as Bunge's Systemist Ontology (BSO), leads to a need for reconsideration of BWW. The authors provide a comparison on pp.4-12. Key changes in Bunge's thinking are argued to have included:

- rather than 'things', the real-world focus has become **'systems'**;
- the focus on systems represents something of a truce between atomising, i.e. describing reality in terms of individual things (which overlooks **inter-relationships**) and holism (which underplays the role of individual things);
- Bunge's initial elements of Composition, Environment and Structure are now complemented by **Mechanism** – "characteristic processes, that make [the system] what it is and the peculiar ways it changes" (p.5);
- Bunge now distinguishes **concrete (or material) systems**, in which energy plays a part, from **conceptual (or formal) systems**, which comprise propositions, classifications, and theories; and
- in concrete systems, events are now the result of **a change in state of a thing**, involving energy conversion, and multiple events form processes. (The conversion and process notions of course also have correlates in conceptual systems).

Importantly, Lukyanenko et al. (2021) argue that BSO builds a bridge between ontology and epistemology, and thereby offers scope for contributions to current developments in challenging areas such as deep learning and explainable AI, in that:

- the notion of a 'phenomenon' becomes explicit. An 'event', which comprises change in the state of a 'concrete system', triggers human sensory apparatus, and thereby is at the intersection of the real world and human perception and cognition;
- as a result of humans' experience of phenomena, humans create 'attributes' for some aspect of those phenomena; and
- observation is purposeful or deliberate perception enlightened by the observer's prior knowledge.

The current status of ontology within the IS discipline might be depicted as an ongoing, if somewhat sporadic, debate between a strongly materialist approach, hardened by its use of formalisms, and a broader and more ambiguous conception that blends acceptance of a 'real world' with conceptual constructs that exist only in the mind.

A further consideration is that limiting ontology to consideration of 'that which exists' is inadequate for the IS discipline. In IS practice, and in IS research conducted using the design science approach, it is necessary to adopt a broad scope-definition of existence to include at least "constructions of future reality" (Ulrich 1999): during the IS design phase, the model that the designer builds does not represent something that exists, but rather something that is intended to come into existence.

Finally a clarification is needed in relation to a secondary use of the term 'ontology' in the IS literature to refer to a particular set of categories and terminology in which to express them, or "an explicit specification of a conceptualization" (Gruber 1993), or "a set of representational primitives with which to model a domain of knowledge or discourse" (Gruber 2009). This results in the use of the plural 'ontologies', which is not appropriate for a generic noun (as distinct from a singular noun). The usage has not yet appeared in the Oxford English Dictionary or the Encycopaedia Britannica. Where the meaning proposed by Gruber is intended, the terms 'an ontological theory' and **'an ontological model'** are preferable, in order to avoid confusion between the informal shorthand for such a specific terminological family, vocabulary or dialect, on the one hand, and the philosophical construct, on the other.

4. Epistemology in the IS literature

Beyond the gathering of data and and its processing into information, IS is concerned with the contribution of that information to the knowledge that is applied by individuals and organisations. Epistemology is the study of knowledge, and its sources, varieties and limits. All work in IS therefore depends on epistemological assumptions – whether or not those assumptions are expressed, and whether or not the academic or practitioner is even aware that they are making those assumptions. This section provides a brief review of approaches that are adopted and argued for within the IS discipline.

Hirschheim (1985) interprets epistemology as referring to "our theory of knowledge; in particular, how we acquire knowledge" (p.10), and refers to "a search for understanding" (p.11), with discipline essential, but with discipline taking many forms. The author identifies stages of development within the western intellectual tradition (pp.14-32) as (1) the arrival of positivism (17th-19th centuries), (2) the entering of anti-positivism (late 19th to early 20th century), (3) logical positivism (early 20th century), (4) the arrival of the (then) contemporary critics (remainder of the 20th century), and (5) the (then) emergent post-positivism (late 20th century), which appeared likely to be more appropriate to the social sciences, through pluralism and tolerance of diversity in epistemological assumptions.

In Iivari et al. (1998), it is argued that epistemological assumptions "are concerned with the nature of knowledge and the proper methods of inquiry" (which closely associates methodology with epistemology). Data and/or information can be interpreted within the realist ontological tradition as 'descriptive facts', or within idealism as socially constructed meanings (p.172). Positivism is characterised as assuming "scientific knowledge to consist of regularities, causal laws, and explanations" whereas anti-positivism "emphasizes human interpretation and understanding as constituents of scientific knowledge" (p.174). Positivism assumes an independent observer, whereas anti-positivism assumes observation by individuals directly involved in the relevant domain. The authors examine five approaches to the development of IS. They infer, primarily from text fragments within published works, the epistemological approach of each. See Table 1.

Table 1. Alternative Epistemological Assumptions Underlying IS Research
Extract from Table 4 of Iivari et al. (1998, p.186)

IS Development Approach	**Epistemology**
Interactionist Approach	Positivist orientation
Speech Act- Based Approach	Antipositivist orientation but some positivist tendencies
Soft Systems Methodology Approach	Dualistic but clearly antipositivist in the case of social systems
Trade Unionist Approach	Primarily positivist
Professional Work Practices Approach	Antipositivist tendencies

The various expressions of the dominant BWW model (Wand & Weber 1988, 1990, Wand 1995, Weber 1997, Wand & Weber 2017) do not explicitly address the question of the epistemological assumptions that BWW embodies, encourages or permits. The analysis in Wyssusek (2006) identifies "the principal assumptions of Bunge's ontology [and by implication of the BWW model] with a view on its epistemological implications" (p.68). Wyssusek contends that the Bunge, and hence BWW, position is a clear example of scientism: that "objective human knowledge is possible ... truth is possible, but only by means of science ... [hence] truth must find its expression in the languages of science, which are logic and mathematics" (p.68). That, the author concludes, places tight limits on BWW's ontological assumptions and hence on the epistemological assumptions that it can encompass. In terms of the alternatives identified by Iivari et al. (1998), and reproduced in Table 1, this places the BWW model firmly in the first, 'Interactionist Approach'.

In defence against such critiques, Weber (1997) argued that " ... the epistemological assumptions underlying data modeling are simply outside [Weber's and Wand's] domain of concern. Again, we take someone's or some group's view of the world to be modeled as given. We do not address the issue of how a person or a group of people have arrived at their world view. ... It is not that Wand and I consider these epistemological issues to be unimportant. ... my own view is that they do not lie at the core of the information-systems discipline, even though they are very important to information-systems praxis" (1997, pp.178-179). The even more substantial claim is made that "epistemological and social-context issues are outside the core of the information-systems discipline" (Weber 1997, p.184). If justified, this would represent a very limiting conception of the nature of the IS discipline. The present work is concerned with practice and practice-relevant research. It accordingly does not subscribe to the proposition that epistemological issues are out-of-scope or peripheral.

Whether or not that narrow scope-definition is justifiable, it appears to be a strong claim to suggest that no implicit epistemological assumptions derive from the adoption of a strongly materialist ontological model. It is arguable that a strong commitment to materialist ontology has a natural tendency towards positivist and even scientistic epistemological standpoints. Another possible interpretation is that BWW is entirely appropriate in domains in which non-human entities predominate (e.g. guidance systems for aircraft and spacecraft, and heavily-automated production control and inventory systems), but that, in systems that involve significant human involvement or that have significant impact on humans, care is needed to identify the epistemological assumptions that are being adopted (DeLuca & Kock 2007), and to adapt them where they are inappropriate to the 'soft' systems context. In the terms of Iivari et al. (1998) in Table 1, this is "Dualistic but clearly antipositivist in the case of social systems", associated with the Soft Systems Methodology Approach.

Becker & Niehaves (2007, p.203) claim to have developed "an epistemological framework for systematically analysing the epistemological assumptions of different research approaches and methods" (p.209). Their motivation, like those before them (e.g. Mingers 2001) is the achievement of "a disciplined pluralism in IS research [which] could facilitate and support multi-method research across particular paradigms" (p.211). Applying their framework, the authors offer a formalisation of "the consensus-oriented interpretivist approach to conceptual modelling" (p.206). See Table 2.

Table 2. Consensus-Oriented Epistemology
Table 5 of Becker & Niehaves (2007, p.207)

Epistemological aspects	Positions advocated by the consensus-oriented approach	
I. What is the object of cognition? (Ontological aspect)	*Ontological realism.* A world exists independently of human cognition, for instance, independent of thought and speech processes.	
II. What is the relationship between cognition and the object of cognition?	*Contructivism.* The relationship of cognition and the object of cognition is determined by the subject.	
III. What is true cognition? (Concept of truth)	*Consensus theory of truth.* A statement is true (for a group), if it is acceptable to the group.	*Semantic theory of truth.* A condition for truth is the differentiation of an object and a meta-language.
IV. Where does cognition originate?	*Kantianism.* Both experience and intellect are sources of cognition. Thoughts are meaningless without content, cognitions are blind without being linked to terms.	
V. By what means can cognition be achieved? (Methodological aspect)	*Inductivism.* Induction is understood as the extension from individual cases to universal phrases, the generalization.	*Deductivism.* Deduction is the derivation of the individual from the universal.

In Riemer et al. (2013), the authors argue that the IS discipline evidences a pervasive and "implicit commitment to a dualist ontology and representationalist epistemology" (p.1). They offer an alternative analysis that draws on "Heidegger's holistic, phenomenological onto-epistemology" (p.10). The particular context their research has as its focus is process modelling, and they seek to uncover "implicit epistemological assumptions about the nature of knowledge and expertise and the resulting implications for eliciting such knowledge from process stakeholders" (p.2). They argue that there are serious doubts about the appropriateness, and value, of conventional assumptions adopted in IS theories about the modelling of realities (pp.4-5). People with skills and expertise cannot be relied upon to have comprehensive propositional knowledge ('knowing that'), as distinct from being reliant on procedural knowledge ('knowing how to'). Even if the relevant skilled people have propositional knowledge, an analyst or consultant without requisite domain-knowledge is unlikely to be able to elicit sufficient codified knowledge to create an adequate model. Further, such models as are created are unlikely to embody a suitable, abstracted representation of the relevant domain: "process modeling needs to take seriously the situatedness of organizational practices and the tacitness of expert know-how" (p.15). The Heideggerian approach leads to the conclusion that "representations cannot claim to correspond with organizational reality in any absolute way. Rather, they have to be taken as the outcome of a political practice that brings to the fore some aspects, but takes out of view others" (p.15).

The epistemological debate within the IS discipline continues, between hard-edged positivist views on the one hand, and several alternative approaches that recognise a considerable degree of indeterminacy or absence of 'a singular truth'. The current status might be depicted as maturing beyond simple either/or arguments. Treiblmaier (2018), interpreting Feyerabend, suggests there are benefits in 'epistemological anarchism' – "an open attitude toward any kind of epistemological foundation that might work" (p. 97). Myers (2018) counters with a preference for 'disciplined methodological pluralism' and "epistemological and methodological diversity" (pp.11,14).

Cuellar (2020) takes theses ideas further. He regrets the tendency towards "the use of the term 'epistemology' to seemingly stand for all metatheoretical commitments" (p.104). He argues for the use of the generic term 'metatheoretic{al} commitments', to encompass the assumptions made in relation to all of ontology, epistemology, axiology (the study of value), logic and their derivative, methodology: "our ... methodology must be suitable for the environment which we study (ontology) and for how knowledge is to be obtained in that environment (epistemology), and our logic must conform to how our metatheoretic commitments indicate that arguments are to be made" (p.107). With Myers, he seeks a 'disciplined metatheoretical pluralism'. This approach has been adopted in the framing of the present paper.

One area in which this has been attempted is in the development of new IS. Design science leans towards positivist epistemological assumptions. Action research and 'soft systems methodologies', on the other hand, are strongly constructivist or interpretivist in their orientation (DeLuca & Kick 2007, Iivari & Venable 2009, Baskerville et al. 2009). In time, we may see the emergence of, if not a reconciliation between positivism and anti-positivism, then perhaps a more tolerant post-positivist attitude, recognising multiple onto-epistemological positions and assumption-sets, each of which it is accepted can, subject to conditions, support the delivery of value within the IS discipline, and within the IS profession.

Looking to the future, what Lukyanenko et al. (2021) characterised as Bunge's Systemist Ontology (BSO), derived from his later and broader works, may provide a basis for paradigmatic shift beyond BWW, through the process of generalisation and subsumation. This sees theories within a field being in some cases overrun by successors, but in other cases absorbed, and reinterpreted as approximations or special cases. The archetypical example is the theories of celestial mechanics of, successively, Aristarchus, Copernicus, Kepler, Newton and Einstein (Koestler 1959).

My focus in this work is IS practice and practice-relevant IS research. A limitation of the purely empiricist view of epistemology is that it does not encompass **imaginary worlds**. A familiar example of imaginary worlds is legendaria, such as Tolkien's Middle Earth and Pratchett's Discworld. Another category is models that were once proposed as explanations of real-world phenomena, but are now discredited, such as the miasma ('bad air') theory of disease, Lamarckian evolution, and the Ptolemaic model of the cosmos. There are also meta-models that are inspired by real-world phenomena but that bear only a limited relationship to it, such as SimCity, Myst, and Greg Bear's MetaVerse.

Some categories of imaginary worlds are relevant to IS. They include **purely formal worlds**, such as finite-state automata, and the rules of draughts/checkers, go, chess, and the myriad board- and computer-games worlds. Another category is **speculative models**, e.g. for short-term meteorological phenomena and long-term climate change, in worlds that do not exist or cannot be

observed. These include conceivable but as-yet unobservable conditions on other planets, but also those on Earth in the past, and those on Earth under possible future conditions radically different from the present such as after a large-scale meteorite strike, a nuclear holocaust, or prolonged emission of greenhouse gasses as a result of human activity.

5. Axiology in the IS literature

Occurrences in the IS literature of the third category of 'metatheoretic assumptions', axiology, are far fewer than for 'ontology' and 'epistemology'. In IS, a narrow interpretation of the term 'value' predominates, limited to economic or even more specifically to financial considerations, as in the term 'shareholder value'. Axiology adopts a broader sense of 'values', encompassing at least individual, social, economic and environmental aspects.

At the level of individuals, various attempts have been made to operationalise human values. Stapleton et al. (2008), writing in the context of large-scale automation and control systems in multi-cultural contexts, applies the highly-cited '10 value-domains' of Schwartz & Bilsky (1990) summarised in Schwartz (2012). This distinguishes Hedonism, Conservation, Openness to Change, Self-Enhancement and Self-Transcendence. Conservation, for example, comprises Conformity/Obedience, Tradition/Humility/Devoutness and Security/Social Order.

On one reading, the BWW approach, with its focus on ontology, may exclude values from its frame of reference: " ... social-context issues are outside the core of the information-systems discipline" (Weber 1997, p.184). On the other hand, recognition of personal and social values is emphasised within a range of IS development methods, including:

- Multiview (Avison & Wood-Harper 1990)
- Soft Systems Methodology (e.g. Checkland 2000)
- Participatory Systems Design (e.g. Gregory 2003)
- Value Sensitive Design (e.g. Friedman et al. 2008)

A recent IS contribution arguing for the reflection of human values is a 'CARE Theory of Dignity amid Personal Data Digitalization' using the elements of claims, affronts, response and equilibrium (Leidner & Tona 2021). A longer-running thread has been the notion of 'stakeholders'. This emerged in the broader management literature (Freeman & Reed 1983), but was quickly applied in IS. Many stakeholders are participants in the process or intervention, in such roles as investor, data source, technology provider, system sponsor and user (Seddon et al. 1999). However, the categories of stakeholders also include "other individuals, groups or organizations whose actions can influence or be influenced by the development and use of the system whether directly or indirectly" (Pouloudi & Whitley 1997, p.3). The term 'usees' is descriptive of non-participating affected by the system (Clarke 1992, Fischer-Huebner & Lindskog 2001, Baumer 2015).

Stakeholder analysis enables IS professionals to appreciate the perspectives of the various participant and usee stakeholders, and the individual, social and economic interests arising from their particular value-sets. This is related to the concept of 'discourse ethics' (Habermas 1991), which proposes that normative validity, or ethicality, arises from a dialectic: discussion and argumentation giving rise to at least mutual understanding, if not resolution. Broader social values are evident in the Information and Communications Technologies for Development (ICT4D) segment of IS, and environmental values in some aspects of Green IS/IT (Watson et al. 2010, Gholami et al. 2016). Social and environmental aspects have have been recognised in literature cognate to IS in such concepts as triple-bottom-line reporting ('people, planet and profits' – Elkington 1994, Milne and Gray, 2013), corporate social responsibility (Sheehy 2014) and corporate sustainability (Schaltegger & Burritt 2005).

These approaches have two aspects. On the one hand, by gaining an understanding of the values of the parties involved in and affected by corporate activities, the corporation can conceive and design those activities so as to attract support and avoid backlash. On the other hand, they constitute recognition by organisations that, although corporations' primary role is the delivery of financial benefits to shareholders, their broader impacts are substantial, and hence they also play significant roles in societal, economic and environmental matters.

A series of studies of the stakeholder perspectives adopted by IS researchers has found that around 90% of all papers reporting research relevant to IS practice adopt a single perspective, treating the interests of all other stakeholders as constraints on the fulfilment of the primary stakeholder's aims; and that around 90% of those papers select the system sponsor as the privileged stakeholder (Clarke & Davison 2020, Clarke et al. 2020). The remaining small proportion of papers reflect an enormous

range of stakeholders and the values they espouse. Even among that limited corpus, however, only a small proportion actively seeks balance between the competing interests of two stakeholders, or among more than two value-sets. This finding is consistent with critical (social) theory which recognises that conflict among actors' interests is endemic to society, that interpretations reflect ideology, and that research must take ideologies into account (Chua 1986). Because the relative power of the actors is a key factor in determining outcomes, critical theorists may adopt an activist stance, e.g. "Critical IS research specifically opposes technological determinism and instrumental rationality underlying IS development and seeks emancipation from unrecognised forms of domination and control enabled or supported by information systems" (Cecez-Kezmanovic 2005, p.19).

The ontological, epistemological and axiological models applied in IS need to reflect the insights of contemporary philosophy. On the other hand, with the ongoing advance of digital laboratories in such fields as meteorology, physics, chemistry, biology and ecology, IS needs ontological, epistemological and even axiological models whose scope is not limited to real-world phenomena.

6. A Pragmatic Metatheoretic Position

My purpose in the series of papers that the present paper is intended to underpin is to present an approach to modelling the real world that is comprehensible by, and useful to, practitioners in the IS profession, and that is therefore appropriate to practice-relevant IS research. A primary domain of application is intended to be the appropriate association of data with identities and entities, which is particularly challenging where the entities are human beings.

To achieve this outcome, the model needs to sidestep the esoteric elements within the philosophical debates, avoid confronting and catering for complexities and intellectual subtleties that rarely arise in practice, and focus on the aspects that have discernible impacts on processes in the relevant parts of the real world. The model needs to use a mix of text, diagrams and performative demonstrators, to limit the use of strict formalisms to the representation of fully-automated processes, and to use formats in a complementary, mutually reinforcing manner.

The conventional ontological positions that correspond with the 'common sense' assumptions of people with no interest in philosophy are argued here to be:

- There is a real world, outside the human mind, where things exist and events occur (realism);
- Humans:
  - cannot directly know or capture those phenomena;
  - can sense and measure those phenomena and create data reflecting them; and
  - can construct an abstract-world model of those phenomena (idealism).

This 'common sense' position evidences considerable similarity to the BWW approach, in that it postulates entities intended to correspond to real things, attributes of entities to represent properties of real things, and changes in attribute-values to reflect changes in the state of real things. Practitioners need to model not only the consensual real world but also formal worlds (such as finite state automata, or the rules of chess), and imaginary worlds (including new schemes during their design phase, and the idealised world intended to be serviced by packaged information systems).

Practical modellers seek a balance between simplicity on the one hand, and complexity on the other, mediated by the usefulness of the model in understanding the world, and in gaining insights into the likely impacts of contingencies and interventions. On the other hand, the practical use of models has to cater for the limitations of modellers to fully appreciate even that part of the real world that attracts their focus. This suggests a leaning towards the more recent, somewhat richer BSO approach, with its preparedness to acknowledge benefits in a holist as well as an atomist view, and its increased focus on the inter-relationships among things and events within a broader system.

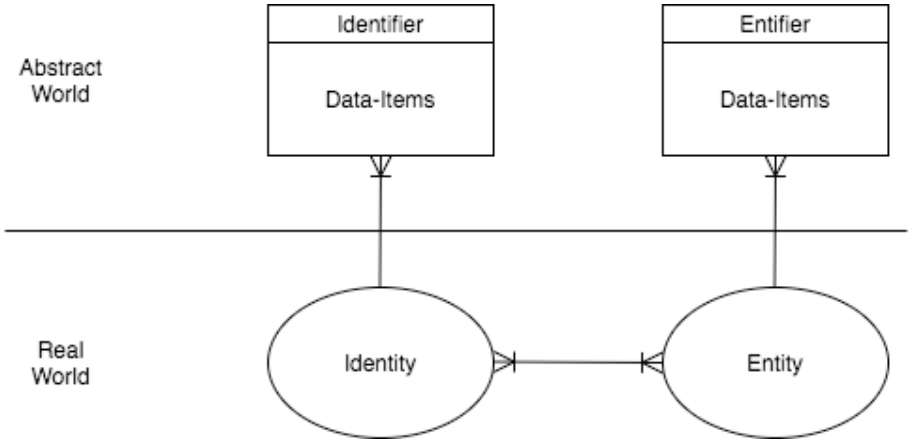
The epistemological aspect of the pragmatic metatheoretic model needs to acknowledge the benefits of applying empiricist thinking to real-world systems, particularly where the entities are all inanimate, their handling is largely mechanical, and codified knowledge exists and is readily transmissible – archetypically, aircraft guidance systems and robotic production-lines. However there is also a need to encompass contexts less amenable to such structured approaches. Sensing and measurement are, in many circumstances, constrained by human perceptual and cognitive apparatus (the anatomy and physiology of eyes and ears, optic and auditory nerves, sensory nervous system, brain, etc.) and mental processes. Codified knowledge can only emerge where individuals' insights can be extracted and structured. Comprehensive propositional ('know that') knowledge may be hard to come by, variously because of unstable phenomena, a high degree of environmental variability, or craft activities with a

strong skills-base and hence a predominance of procedural ('know how to') knowledge. A pragmatic approach must support modelling where there is no expressible, uncontested, singular 'truth'.

The stream of research of which this is the foundational paper is intended to produce a replacement framework to underlie effective research and practice in (id)entity management. IS practice has been bedevilled by challenges in this area for decades. Progress depends on overturning or subsuming an entrenched but inadequate model. A pragmatic metatheoretic model is needed that reflects insights from the relevant branches of philosophy.

Of necessity very briefly, the essence of the emergent model is more careful reflection of objects, artefacts and living things in data collections. Conventionally, each real-world thing is reflected in the abstract world of organisational data collections as a record containing data-items, of which some serve to distinguish the particular instance within the category. The mainstream model embodies the the left-hand side of the over-simplified depiction in Figure 1. However, that model overlooks the phenomena modelled on the right-hand side of the Figure. Real-world entities exist, which may adopt multiple identities in different contexts (such as devices using successively-different IP-addresses, people as employees, as consumers, as volunteers and as social and political actors). In addition, multiple identities may adopt a single real-world identity at different times (such as computer processes running an investor's transactions, or successive Chairs of a company Board) or at the same time (such as software agents conducting real-time share-trading, or the Directors of a company).

Figure 1: An Over-Simplified (Id)Entity Management Model



The axiological component of the pragmatic model needs to accommodate the existence of simple good/bad virtues in some systems, and of deontic / compliance-based constraints in others. It must also encompass contexts that are teleologically-driven, seeking utility in the sense of impacts and outcomes that are consistent with purpose. Crucially, with IT embedded within socio-economic-environmental complexes, the desired model must enable its users to cope with the multiple value-sets associated with different stakeholders, with at least some degree of conflict inevitable. Hence utility needs to be defined multi-dimensionally and solutions need to be based on tolerance, negotiation and compromise. The simpler contexts involve conflicts only between the system-sponsor's economic needs and system-users' economic and social desires. More complex contexts extend to usees' needs, and to environmental objectives. The pragmatic model being developed needs to enable the embodiment of varied treatments of values. In the foreground example of (id)entity management, this may arise with objects (e.g. meteorites and rocks from Mars), with artefacts (e.g. the bust of Nefertiti or a gas-fired power station), with animals, and particularly with human beings.

7. Conclusions

The practice of IS, and the conduct of research relevant to IS practice, are instrumentalist activities. They have a shared need for a pragmatic metatheoretic model that reflects the relevant insights of centuries of philosophical enquiry, but adopts an approach that is simple and understandable, yet provides sufficient richness.

This paper has investigated three aspects of philosophical enquiry, dealing with the questions of existence, knowledge and value. Their application within the IS discipline was examined, in order to identify the range and diversity of possible propositions. A pragmatic selection among the alternatives was made. In relation to each of the aspects of philosophical enquiry, a pluralistic approach was

adopted, accommodating both longstanding, narrower ideas about existence, knowledge and value, and more ambiguous and tolerant ideas, in most cases of more recent origin. The circumstances to which each alternative is applicable were outlined. This lays firm foundations for the articulation of the pragmatic metatheoretic model in subsequent papers, in order to support IS practice and practice-oriented IS research, with particular reference to the domain of identity management.

8. References

Avenier M.-J. & Thomas C. (2015) 'Finding one's way around various methodological guidelines for doing rigorous case studies: A comparison of four epistemological frameworks' Systè mes d'Information et Management 20, 1 (2015) 4, 61-98, at https://halshs.archives-ouvertes.fr/halshs-01491454/file/Avenier%20and%20Thomas%20SIM%202015%20author%20copy.pdf

Avison D.E. & Wood-Harper A.T. (1990) 'Multiview: an exploration in information systems development' Alfred Waller Limited, 1990

Baskerville R., Pries-Heje J. & Venable J.R. (2009) 'Soft design science methodology. Proc. 4th Int'l Conf. on Design Science Research in Information Systems and Technology (DESRIST), May 2009, at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.553.6621&rep=rep1&type=pdf

Baumer E.P.S. (2015) 'Usees' Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI'15), April 2015

Becker J. & Niehaves B. (2007) 'Epistemological perspectives on IS research: a framework for analysing and systematizing epistemological assumptions' Information Systems Journal 17, 2 (2007) 197-214

Bunge M. (1977) 'Treatise on Basic Philosophy: Volume 3: Ontology I: The Furniture of the World' Reidel, 1977

Bunge M. (1979) 'Treatise on Basic Philosophy: Volume 4: Ontology 11: A World of Systems' Reidel, 1979

Cecez-Kecmanovic D. (2005) 'Basic assumptions of the critical research perspectives in information systems' Ch. 2 in Howcroft D. & Trauth E.M. (eds) (2005) 'Handbook of Critical Information Systems Research: Theory and Application', pp.19-27, Edward Elgar, 2005

Checkland P. (2000) 'Soft Systems Methodology: A Thirty Year Retrospective' Systems Research and Behavioral Science Syst. Res. 17 (2000) S11–S58, at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.133.7381&rep=rep1&type=pdf

Chen P.P.S. (1976) 'The Entity-Relationship Model - Toward a Unified View of Data' ACM Transactions on Database Systems 1 (March 1976) 9-36

Chua W.F. 'Radical Developments in Accounting Thought' The Accounting Review 61, 4 (October 1986) 601-632

Clarke R. (1992) 'Extra-Organisational Systems: A Challenge to the Software Engineering Paradigm' Proceedings of the IFIP World Congress, Madrid, September 1992, PrePrint at http://www.rogerclarke.com/SOS/PaperExtraOrgSys.html

Clarke R. & Davison R.M. (2020) 'Through Whose Eyes? The Critical Concept of Researcher Perspective', Journal of the Association for Information Systems, 21, 2 (March-April 2020) 483-501, PrePrint at http://rogerclarke.com/SOS/RP.html

Clarke R., Davison R.M. & Jia W. (2020) 'Researcher Perspective in the IS Discipline: An Empirical Study of Articles in the Basket of 8 Journals' Information Technology & People 33, 6 (October 2020) 1515-1541, PrePrint at http://www.rogerclarke.com/SOS/RPB08.html

Cuellar M.J. (2020) 'The Philosopher's Corner: Beyond Epistemology and Methodology - A Plea for a Disciplined Metatheoretical Pluralism' The DATABASE for Advances in Information Systems 51, 2 (May 2020) 101-112

DeLuca D.C. & Kock N. (2007) 'Publishing Information Systems Action Research for a Positivist Audience' Communications of AIS 19, Article 10, 1-36, at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.124.1051&rep=rep1&type=pdf

Elkington J. (1994) 'Towards the Sustainable Corporation: Win-Win-Win Business Strategies for Sustainable Development' California Management Review 36, 2 (1994) 90-100

Fischer-Huebner S. & Lindskog H. (2001) 'Teaching Privacy-Enhancing Technologies' Proc. IFIP WG 11.8 2nd World Conference on Information Security Education, Perth, Australia, 2001

Freeman R.E. & Reed D.L. (1983) 'Stockholders and Stakeholders: A New Perspective on Corporate Governance' California Management Review 25, 3 (1983) 88-106

Friedman B,, Kahn P.H. & Borning A. (2008) 'Value Sensitive Design and Information Systems', Ch.4, pp.69-101 in 'The Handbook of Information and Computer Ethics' (Eds.) Himma K.E. & Tavani H.T., Wiley, 2008, at https://faculty.washington.edu/pkahn/articles/c04_LR_2008-04-01-3.pdf

Gholami R., Watson R.T., Hasan H., Molla A. & Bjorn-Andersen N. (2016) 'Information Systems Solutions for Environmental Sustainability: How Can We Do More?' Journal of the Association for Information Systems 17, 8 (2016) 521-536

Glasersfeld E. von (2001) 'The Radical Constructivist View of Science' Foundations of Science, Vol. 6, pp.31-43

Gregory J. (2003) 'Scandinavian Approaches to Participatory Design' Int. J. Engng Ed. 19, 1 (2003) 62-74, at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.157.8443&rep=rep1&type=pdf

Gruber T.R. (1993) 'A translation approach to portable ontologies' Knowledge Acquisition 5, 2 (1993) 199-220

Gruber T. (2009) 'Ontology', in Liu L. & Özsu M.T. (Eds.), Encyclopedia of Database Systems, Springer-Verlag, 2009, at http://tomgruber.org/writing/ontology-definition-2007.htm

Habermas J. (1991) 'Moral Consciousness and Communicative Action' MIT Press, 1991

Hirschheim R. (1985) 'Information systems epistemology: an historical perspective' in Mumford E., et al. (Eds) 'Research Methods In Information Systems, North-Holland, 1985

Iivari J., Hirschheim R. & Klein H.K. (1998) 'A Paradigmatic Analysis Contrasting Information Systems Development Approaches and Methodologies' Information Systems Research 17, 3 (June 1998) 179-218, at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.553.5466&rep=rep1&type=pdf

Iivari J. & Venable J.R. (2009) 'Action research and design science research - Seemingly similar but decisively dissimilar' Proc. ECIS 2009 73, at https://core.ac.uk/download/pdf/301355252.pdf

Koestler A. (1959) 'The Sleepwalkers: A History of Man's Changing Vision of the Universe' Hutchinson, 1959

Leidner D.E. & Tona D. (2021) 'The CARE Theory of Dignity amid Personal Data Digitalization' MIS Quarterly 45, 1 (March 2021) 343-370

Lukyanenko R., Storey V.C. & Pastor O. (2021) 'Foundations of information technology based on Bunge's systemist philosophy of reality' Software and Systems Modeling (2021), at https://link.springer.com/article/10.1007/s10270-021-00862-5

Milne M.J. & Gray R. (2013) 'W(h)ither Ecology? The Triple Bottom Line, the Global Reporting Initiative, and Corporate Sustainability Reporting' Journal of Business Ethics 118, 1 (2013) 13-29

Mingers J. (2001) 'Combining IS Research Methods: Towards a Pluralist Methodology' Information Systems Research 12, 3 (2001) 240-259, at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.335.8089&rep=rep1&type=pdf

Myers M.D. (2018) 'The philosopher's corner: The value of philosophical debate: Paul Feyerabend and his relevance for IS research' The DATA BASE for Advances in Information Systems 49, 4 (November 2018) 11-14

Opdahl A. L. (2006) 'Response to Wyssusek's 'On Ontological Foundations of Conceptual Modelling'' Scandinavian Journal of Information Systems 18, 1 (2006) 95–106, at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.156.7572&rep=rep1&type=pdf

Pouloudi A. & Whitley E.A. (1997) 'Stakeholder Identification in Inter-Organizational Systems: Gaining Insights for Drug Use Management Systems' European Journal of Information Systems 6, 1 (1997) 1-14

Riemer K., Johnston R.B., Horvoka D. & Indulska M. (2013) 'Challenging the philosophical foundations of modeling organizational reality: The case of process modeling' Proc. 34th Int'l Conf. Infor. Syst., at https://www.researchgate.net/profile/Kai-

Riemer/publication/259390549_Challenging_the_Philosophical_Foundations_of_Modeling_Organizational_Reality_The_Case_of_Process_Modeling/links/02e7e52b5bac7203c1000000/Challenging-the-Philosophical-Foundations-of-Modeling-Organizational-Reality-The-Case-of-Process-Modeling.pdf

Schwartz S.H. (2012) 'Basic Human Values: An Overview' Online Readings in Psychology and Culture, 2, 1 (2012), at https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.510.6950&rep=rep1&type=pdf

Schwartz S.H. & Bilsky W. (1990) 'Toward a Theory of the Universal Content and Structure of Values: Extensions and Cross-Cultural Replication' Journal of Personality and Social Psychology 58, 5 (1990) 878-891

Schaltegger S. & Burritt R. (2005) 'Corporate sustainability' Ch. 5, pp.185-222 in (Eds.) Folmer H. & Tietenberg T. 'The International Yearbook of Environmental and Resource Economics, 2005/2006, Edward Elgar, 2005

Seddon P.B., Staples S., Patnayakuni R. & Bowtell M. (1999) 'Dimensions of Information Systems Success' Communications of the AIS 2, 20 (1999) 1-60

Sheehy B. (2014) 'Defining CSR: Problems and Solutions' Journal of Business Ethics 131 (21015) 625–648, at https://www.researchgate.net/profile/Benedict-Sheehy/publication/253236902_Defining_CSR_Problems_and_Solutions/links/578d854708ae59aa66815cd7/Defining-CSR-Problems-and-Solutions.pdf

Stapleton L., Byrne G. & Freeman A. (2008) 'The Use of an Axiological Lens to Review Globalised Automation and Control Systems Projects' Proc. 17th World Congress, Int'l Federation of Automatic Control, Seoul, Korea, July 6-11, 2008, at https://folk.ntnu.no/skoge/prost/proceedings/ifac2008/data/papers/2171.pdf

Treiblmaier H. (2018) 'The philosopher's corner: Paul Feyerabend and the art of epistemological anarchy – A discusion of the basic tenets of Against Method and an assessment of their potential usefulness for the information systems field' The DATA BASE for Advances in Information Systems 49, 2 (May 2018) 93-101

Ulrich F. (1999) 'Conceptual Modelling as the Core of the Information Systems Discipline - Perspectives and Epistemological Challenges' Proc. AMCIS 1999, 240, 695-697, at https://core.ac.uk/download/pdf/301353416.pdf

Wand Y., Monarchi D.E., Parsons J. & Woo C.C. (1995) 'Theoretical foundations for conceptual modelling in information systems development' Decision Support Systems 15, 4 (1995) 285-304

Wand Y. & Weber R. (1988) 'An Ontological Analysis of some fundamental Information System Concepts' Proc. 9th Int'l Conf. on Infor. Syst., pp.213–224

Wand. Y & Weber R. (1990) 'Toward a Theory of the Deep Structure of Information Systems' Proc. 11th Int'l Conf. Infor. Syst., pp.61–71

Wand Y. & Weber R. (2017) 'Thirty years later: some reflections on ontological analysis in conceptual modeling' J. Database Manag. 28, 1 (2017) 1–17

Watson R.T., Boudreau M.-T. & Chen A.J. (2010) 'Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community' MIS Quarterly 34, 1 (2010) 23-38

Weber R. (1997) 'Ontological Foundations of Information Systems' Coopers & Lybrand Research Methodology Monograph No. 4, 1997

Winograd T. & Flores F. (1986) 'Understanding Computers and Cognition: A New Foundation for Design' Ablex, 1986

Wyssusek B. (2006) 'On ontological foundations of conceptual modelling' Scand. J. Inf. Syst. 18, 1 (2006) 63–80, at https://core.ac.uk/reader/301357860

Acknowledgements

This is the first published version of the foundation work in a series of manuscripts being progressively released into the author's own repository at http://rogerclarke.com/. It has benefited from substantial and valuable comments from the ASIC reviewers and program chairs. I have also had valuable feedback from Ron Weber of the University of Queensland, and from Roger Clarke (no relation), of Queens University Belfast, only some of which has been reflected in this version.