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# From Substantialist to Process Metaphysics – Exploring Shifts in IS Research

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**Abstract.** This article examines the shifts in Information Systems (IS) research from a positivist to interpretive to sociomaterial paradigm by demonstrating how the shifts reflected the move from substantialist towards process metaphysics. Such metaphysical grounding provides a foundation for deeper understanding of paradigm differences and the struggles when shifts occur. After a brief historical overview of substantialist and process metaphysics and a summary of their key assumptions, the article explores paradigm shifts in IS research and highlights the underlying metaphysical nature of surrounding difficulties and controversies. The article advances the paradigm debate by drawing attention to the metaphysical nature of paradigmatic shifts in IS research and by opening up intellectual space for conceiving and understanding novel research approaches beyond Burrell and Morgan's model [1].

**Keywords:** substantialist metaphysics · process metaphysics · IS research · positivist paradigm · interpretive paradigm · sociomaterial paradigm · paradigm debate.

Labels in philosophy and cultural discourse have the character that Derrida ascribes to Plato's pharmakon: they can poison and kill, and they can remedy and cure. We need them to help identify a style, a temperament, a set of common concerns and emphases, or a vision that has determinate shape. But we must also be wary of the ways in which they can blind us or can reify what is fluid and changing.

Richard J. Bernstein

## 1 Introduction

Metaphysics is the branch of philosophy broadly defined as the study of the nature of being, traditionally concerned with basic questions: What is there? and What is it like? [2, 3]. The task of metaphysics is to clarify fundamental notions of existence, entities and processes, space and time, mind and matter, and to articulate a conceptual framework for understanding the world and grounding human knowledge [4]. Metaphysical assumptions thus provide a foundation, a worldview, that enables seeing, understanding and investigating the world, anything that exists. A consistent set of metaphysical assumptions is called a paradigm [1], [5, 6]. Any research inquiry is grounded in a particular worldview, a paradigm, that legitimizes and limits what is

researched, the nature of knowledge and the ways research is conducted and knowledge claims created.

Classification of paradigms by Burrell and Morgan [1] represents a significant milestone that changed scholarly discourse in social sciences by defining the metaphysical assumptions underpinning major paradigms, namely the functionalist (positivist), interpretive, radical humanist and radical structuralist. Burrell and Morgan's model of paradigms had an enormous impact on social sciences, including organization studies and Information Systems (IS), primarily because it recognized non-functional (that is, non-positivist) paradigms while at the same time protected the dominant functionalist (positivist) paradigm from raising criticism [7]. The model, however, has also had some unintended implications: its use tended to reify the rigid notion of paradigms and its dimensions of differentiation (objective vs subjective; regulation vs radical change) obscured "important differences in current research orientations and lead to poorly formed conflicts and discussions" [7] (p. 191). The paradigms (*labels*) that meant to focus attention and *cure* have been increasingly used to fix and police borders and fight paradigm wars, thus limiting rather than enhancing research opportunities.

The IS discipline followed these developments in social sciences albeit with some delays. A study of publications in the key IS journals in the 1980s by Orlikowski and Baroudi [8] found that 96.8% of empirical papers adopted a positivist paradigm. The landmark 1984 Manchester Working Conference [9] alerted the IS community to these developments in social sciences and opened up new research approaches and opportunities. However, in their study of publications during the 1990s in a larger set of IS outlets Chen and Hirschheim [10] found that positivist research continued to dominate (adopted by 81% of empirical papers). While they welcomed the decreasing dominance of positivist research, Chen and Hirschheim called for renewed efforts by interpretive researchers and the change of editorial policies [10].

Since then the IS research landscape has significantly changed. The increasingly digitized, networked and global world and the new phenomena emerging with ubiquitous, pervasive and embedded information, communication and mobile technologies, have radically transformed the landscape and texture of the contemporary IS problematic (see e.g. [11, 12, 13, 14, 15]). The range and complexity of IS problems are increasing beyond the IS discipline's ability to imagine and examine. Researchers are therefore pushing for expansion of intellectual boundaries by exploring new research opportunities and proposing new research approaches [16, 17, 18, 19, 20, 21, 22].

While the interpretive paradigm increased prominence and acquired legitimacy [23, 24] its metaphysical assumptions limited researchers' ability to deal with the emerging IS phenomena. Framed in opposition to positivism the interpretive paradigm remained within the confines of the Burrell and Morgan model [1]. Both have been critiqued for their failure to account for the complexity and uncertainty of contemporary IS phenomena and in particular the puzzling and fluid entanglement of the social and the technological [16], [18], [21], [25, 26, 27, 28, 29]. A radically novel

sociomaterial approach has been proposed that, in simple terms, assumes an ever-changing world that is continuously re-constructed and re-assembled out of heterogeneous materials [16], [18]. While the sociomaterial approach drew the imagination of IS and organization studies scholars, its distinct nature has been questioned (e.g. [25], [30]) and its assumptions considered wrong (e.g. [27]). The debate on sociomateriality has obscured rather than revealed important distinctions, leading to poorly grounded and misleading conflicts.

What is particularly striking is that the recent paradigm debate could no longer be productively grounded in Burrell and Morgan's paradigm model [1] because the relevance of its dimensions of differentiation has progressively diminished [7], [31]. Grounded in the metaphysical separation of the subject and the object, the "subjective-objective" dimension "reproduces a neo-positivist philosophy of science and obscures the nature of other research programs" [7] (p. 194). The "subjective-objective" dimension has thus become progressively "eroded" [31] (p. 261) while the "regulation-radical change" dimension has been compromised [7]. We therefore need not only new paradigms but also and importantly a different metaphysical grounding to allow for emerging paradigms and for understanding new distinctions among paradigms – distinctions that would enrich and stimulate the paradigm debate and help the IS discipline produce significant and relevant scholarship.

In light of the above discussion, my aim in this paper is i) to propose an alternative metaphysical distinction – that between substantialist and process metaphysics – as a potentially useful grounding for understanding different paradigms and ii) to show how such metaphysical grounding enables new insights into differences among research paradigms and thereby contributes to the contemporary IS paradigm debate.

To achieve these aims and put the debate in a historical context, I first present a brief historical overview of substantialist and process metaphysics and then propose a comparative review of their key assumptions. This is followed by the analysis of paradigmatic shifts in IS research – from positivist to interpretive to sociomaterial research approaches – grounded in differences among the substantialist and process metaphysics. The paper advances the paradigm debate by drawing attention to a metaphysical nature of paradigmatic shifts in IS research and by opening up intellectual space for conceiving and understanding novel research approaches beyond the Burrell and Morgan model [1]. The paper concludes with suggestions for expanding this debate further.

## **2 Historical Roots of Substantialist and Process Metaphysics**

The controversial question about the nature of reality that we are currently struggling with is much older than we typically acknowledge. Whether the reality consists of substances (defined by bundles of properties) or processes is indeed a perennial question, vigorously debated since antiquity. As philosophers throughout the history of thought have attempted to deal with and explain experiences of permanence and

change, they have argued opposing positions by giving primacy to either Being or Becoming.

Heraclitus (born ca. 560 BC) stands out as the first philosopher of Becoming, who argued that the world is in constant and ubiquitous flux and that everything is always flowing in some respects [32]. Considered the founder of the process philosophy [33, 34], Heraclitus opposed the view that substances are fundamental constituents of the world and posited that the world consists of constant metaphysical flux (“an ever living fire”). He thus considered processes ontologically primary and substances secondary. His metaphysics of constant flux (attributed to Heraclitus by Aristotle and Plato) was famously illustrated by the expression that it is not possible to step into the same river twice. While the river in everyday usage is assumed to be the “same river” whenever we step into it, the river is constituted of constant flow and keeps changing even while we step in. River thus cannot be seen as an object or thing but as a continuous flow. Heraclitus’ metaphysics of constant flux provided a foundation for processual thinking and became seminal in the history of Western process philosophy.

Heraclitus’ worldview as perpetual change and becoming stands in stark contrast to Parmenides, Leucippus and Democritus’ worldview of fixed entities (subjects, objects, things), that is *pure being* as the underlying reality. The struggle between the two worldviews, that is, between the primacy of Becoming or Being, was first articulated by Plato [35]. He agreed with the Heraclitus’ view that the perceptible world of ordinary experiences is processual but argued that this world is less real, being only a reflection of the world of Forms. For Plato it is Forms that really exist and particular physical objects get real when they participate in the Forms. Plato thus established the primacy of Being as the eternally unchanging Forms in contrast to Heraclitus’ primacy of Becoming and the metaphysics of constant flux.

Aristotle (384–322 BC) rejected Plato’s conceptions of the two worlds and argued that our natural world is real. Aristotle followed Heraclitus claiming that physical objects or matters are constantly changing, and that substances are generated as matter takes on form [36]. While substances are central to Aristotle’s metaphysics it also included potency, activity (*energeia*), motion (*kinesis*) and change as fundamental categories. Aristotle’s metaphysics was thus interpreted as both a foundation for substantialist metaphysics, and also an important contributor to process metaphysics.

Since antiquity, the struggle for the primacy between Being and Becoming subsided for quite some time only to be revived by Descartes (1596–1650), the “father of modern philosophy”. According to Descartes, the world is composed of substances that are either mental or physical but share some common features. Mesle summarizes Descartes’ substantialist assumptions as follows [33] (p. 44):

1. Substances exist independently of other substances. Descartes wrote, “By substance, we can understand nothing else than a thing which so exists that it needs no other thing in order to exist.”

2. Substances are also those unchanging realities that stand under (hence sub/stance) their qualities and endure unchanged through the changes of those qualities.

Descartes' famous "mind-body dualism" implied an essential distinction and an interdependent existence of the mind (or soul, a thinking) and the body (an extended, non-thinking thing). This dualism enabled him to articulate on the one hand, a rational basis for the soul's immortality and on the other, formulate a theory of nature as the mechanistic physics that excluded the mind and mentality. Descartes's substantialist metaphysics has had a long lasting influence on Western thought and provided a foundation for the subsequent development of the "scientific method".

A significant rebirth of process thought happened at the end of the 18th and early 19th century with important contributions by German philosophers Fichte (1762–1814), Schelling (1775–1854) and Hegel (1770–1831). In response to Kant's "transcendental idealism", Fichte, Schelling and Hegel drew attention to the processual nature of the "transcendental subject" and focused on the process by which knowable appearances are generated. For Hegel anything that exists is never stable but instead constantly changing through a dialectic process of conflicting opposites that form an inherently unstable whole.

The confrontation of substantialist and process metaphysics continued particularly vigorously in late 19th and 20th century. An alternative approach to Hegel's dialectical view of reality articulated by Whitehead's (1861–1947) speculative process metaphysics describes the world consisting of entities as "actual occasions":

"Actual entities" – also termed "actual occasions" – are the final real thing of which the world is made up. There is no going behind entities to find anything more real. They differ among themselves [in their importance and diversity of functions] ... yet in the principles which actuality exemplifies all are on the same level. The final acts are, all alike, actual entities; and these actual entities are drops of experience, complex and interdependent. [37] (p. 18)

Whitehead rejected the various dualisms, what he called the "bifurcation of nature". For Whitehead the world is composed of the *becoming* and *perishing* as relational processes – complexes of actual experiences that are produced by occasions. Actual entities are events that are created of past actual entities or in Whitehead's words they prehend previous entities. Whitehead named the concrete process of becoming of an actual entity "conrescence". These analytical concepts are key to understanding Whitehead's innovative process metaphysics which assumes that "temporal occasions of experience actively constitute one another in the flow of time, ... where the force of his complex theoretical scheme becomes apparent" [38] (p. 8).

Whitehead's contemporaries James (1842–1910) and Dewey (1859–1952) developed a process-based pragmatic metaphysics. Similar to other pragmatists both James and Dewey rejected many Cartesian dualisms. Dewey and Bentley for instance wrote: "What have been completely divided in philosophical discourse into man and world,

inner and outer, self and not-self, subject and object, individual and social, private and public, etc., are in actuality parties in life-transactions” [39] (p. 248). Central to Dewey’s philosophy is *experience* as part of the interaction with environment, “the dynamic participation, the continuing process of an organism’s adjustment not simply to enviroing conditions but within a biological (physical) and cultural environment” [40] (p. 9). Through such interaction and participation humans acquire meaning, determine situations that occur, engage in cooperative behaviour and actualize their potentialities.

Continuing exploration of phenomenal experience, but within the tradition of continental philosophy, Bergson (1859–1941) considered that the processual character of being was outside of human cognitive reach. Seibt [34] explained Bergson’s view: “when we carefully attend to what we take in during conscious experience and who we are, without forcing a conceptualization of that experiential content or the act of experience, we find not a relation and ready-made relata but an interactivity or ongoing interfacing with the world”. Referring to “beings entangled with the world” Bergson emphasized an immediate experience that allowed humans to intuitively capture the dynamics of becoming and the flow of duration (“durée”). Bergson used *durée* to express the notion of “real time” that is experienced rather than measured [41] which, as Linstead [42] explains, makes a distinct contribution to process metaphysics:

spatialized time is time stripped of its intrinsic heterogeneity ...  
[which] is essential to deterministic approaches to experience ...  
[that assumes] life unfurls along its prescribed path according to the  
laws of nature. But for Bergson duration is definitely creative. Every  
emerging instant is new, unique, and novel. ... Past, present, and future  
as memory, experience, and anticipation form duration where  
the real and the virtual meet. [42] (p. 5)

As this brief and inevitably limited review shows, process thought and process metaphysics have developed in opposition to substantialist metaphysics (vice versa is true as well) since antiquity and disputes are far from being settled. The revival of process thought in the last century, inspired in particular by developments in physics, was fuelled in the last 20–30 years by technological developments and transformative processes in society and the economy. This review shows the rich tapestry of process thinking and a broad variety of process philosophies. As Rescher puts it, “the unity of process philosophy is not doctrinal but thematic” [43] (p. 45). Indeed, we can see that they all share commitment to the primacy of Becoming over Being and the processual understanding of the world. These philosophers, as Helin and colleagues explain, “work from within things, staying with them, suspicious of abstracting too far into hierarchies of being; they stick with things and experience of things, rather than reaching into a more certain, stable and invariant world of ideas” [44] (p. 3).

### 3 Key Assumptions: A Comparative View of Substantialist and Process Metaphysics

From Plato and Aristotle to Descartes and onwards the world is seen as composed of substances, self-contained entities that exist independently of other substances. Substances are described by qualities or properties that may and do change while they (substances) persist and remain unchanged. Descartes' wax argument illustrates substantialist ontology and its logic [45]. A piece of solid white wax is described by its particular shape, size, colour, consistency, weight and scent, that is, by its specific properties [45]. When the piece of wax melts and becomes liquid it loses all its properties that initially distinguished it from other entities. However, Descartes explains, due to our mind and our intellectual abilities, we still believe this is the same wax implying that the substance of wax remains the same, despite the change of its specific properties. If we imagine, as Mesle does, that the world is destroyed this piece of wax would still exist in the empty space as it does not need anything else to exist [33] (pp. 44–45).

The wax example shows another important connection: between the substance-property worldview and the subject-predicate structure of language. Sentences such as “the wax is white”, “the wax is hard” or “the wax smells like honey” describe the subject “the wax” and its properties or qualities. The subject (the wax) persists and is considered the same while predicates (properties) change. The wax exists independently of its properties, and thus remains unchanged when these properties change. The common sense of our cultural heritage implies that the grammatical structure – the subject and its predicates – corresponds to the structure of reality [33], [37]. Such a view of reality, as Whitehead comments, “expresses a useful abstract for many purposes of life. But whenever we try to use it as a fundamental statement of the nature of things, it proves itself mistaken. ... But it has had one success: it has entrenched itself in language, in Aristotelian logic, and in metaphysics” [37] (p. 79).

Process metaphysics has been proposed in opposition to and by contesting substantialist metaphysics throughout history.<sup>1</sup> First it is the founding notion of a thing, an entity or a subject defined by its properties/attributes/qualities that was contested. Responding to the wax argument and also to the view of persistent subject, mind, self, body or personality, defined by particular qualities (physical or mental) Mesle argued:

if you take away all of those qualities, there is simply nothing left. You are a bundle of qualities, and a dynamic, changing bundle at that. Some qualities in the bundle are more persistent than others, but there is no unchanging “self”, no mental substance that endures unchanged through the changes of qualities or that exists independently of those qualities so as to remain if they were all taken away. [33] (p. 47)

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<sup>1</sup> The contesting also goes the other way around as the “revolt against process” thinking in contemporary philosophy [43].



Mesle rejects the idea of an unchanging self or a mental substance that endures. While he admits that there is a bundle of dynamic qualities that can describe “self”, together with Whitehead he argues that “your mind or soul is the cumulative flow of your experience [over time]. You have a sense of self because of this continuity” [33] (p. 49).

In Table 1 I summarize the key claims of substantialist metaphysics presented comparatively with those of relational process metaphysics, discussed in this section.

**Table 1.** Comparative assumptions of substantialist and process metaphysics

	<b>Substantialist metaphysics</b>	<b>Process metaphysics</b>
<b>Major focus</b>	Substantialist metaphysics is concerned with “what there is”	Process metaphysics is concerned with “what is occurring” and “ways of occurring”
<b>Foundational constituents of reality</b>	Primary units of reality are things, subjects or entities as enduring, self-contained, bounded <i>substances</i> Substantialist metaphysics gives primacy to <i>beings</i> – things, subjects, entities or substances defined by properties or qualities	The primary units of reality are <i>processes</i> : reality is conceived as confluence of processes Process metaphysics gives primacy to <i>becoming</i> as “the mode of being” as well as the “processes that generate different kinds of dynamic beings”
<b>Other constituents of reality: derivative concepts</b>	Processes are ontologically understood as modifications of properties typically due to relationships between substances; while properties may change through processes substances persist, remaining what they essentially are Processes are “owned”, they are processes <i>of</i> specific substances (reductionist view of processes)	<i>Being</i> is constituted by its becoming; being is dynamic, created in relational processes Persistent entities are <i>enduring</i> patterns of processes (Whitehead)
<b>The notion of time</b>	Time is considered universal, absolute, linear and measurable Time, as “clock-time”, measures movement and events in space	Time is inherent in processes, an inextricable part of a lived <i>durée</i> (Bergson) There is no singular absolute clock-time but rather a multiplicity of clock-times that belong to multiple processes (realities)

The major focus of substantialist metaphysics is the question of “what there is” implying its primary concern with Being. It is things, entities or subjects as self-contained, bounded, enduring substances that are seen as foundational constituents of reality. Things, entities or subjects (such as technologies, organizations, individuals) have properties that define them. These properties may change without changing their substances (as in the wax example). Changes of properties occur due to relationships between things, subjects or entities, which is a way to recognize the existence of processes in substantialist metaphysics. Processes are thus derivative concepts as they are processes *of* specific substances involving the change of properties.

Process thinkers draw from our intuitive understanding of reality as flows and dynamic relational processes that we experience in our everyday lives. Process metaphysics reflects our experience of ongoing dynamics of our lives and the world we live in and integral to them the ongoing becoming of entities (individuals, organizations, information systems) that are only temporally stabilized in the course of events.

Process philosophy starts from experience and encourages us to open up our thinking to the richness and depth of our experience and intuition. Seibt [34] notes that “process philosophers (e.g., Whitehead) argue that the traditional notion of substance (a time-invariant, necessarily located particular) precisely lacks any experiential grounding, while process philosophy can draw on the experience we are most intimately familiar with, namely, the way in which we experience ourselves”.

Process metaphysics thus differs fundamentally from substantialist metaphysics by not focusing on “what there is” but instead on “what is occurring” and “ways of occurring” (see Table 1). Process metaphysics therefore considers processes as fundamental constituents of reality and gives primacy to “becoming” as the “mode of being” as well as the processes that generate different kinds of “dynamic beings” [4], [34], [37], [43], [46]. Reality is conceived as a web of relational processes [33] or a “confluence of processes” [47] that are continuously coming about.

In response to attempts to downplay the distinctive processual thinking Rescher [4] critiqued what he calls the “process reducibility thesis” that portrays processes as changes of things universally accepted as existing in nature. Rescher later wrote:

What is characteristically definitive of process philosophizing as a distinctive sector of philosophical tradition is not simply the commonplace recognition of natural process as the active initiator of what exists in nature, but an insistence on seeing process as constituting an essential aspect of everything that exists – a commitment to the fundamentally processual nature of the real. For the process philosopher is, effectively by definition, one who holds that what exists in nature is not just originated and sustained by processes but is in fact ongoingly and inexorably characterized by them. On such a view, process is both pervasive in nature and fundamental for its understanding. [48]

It is the processual nature of reality, the pervasive, ongoing, relational processes that are foundational and thus of primary interest in our quest for understanding the world and anything in the world. In other words, anything that we experience in the world is always in becoming. What we call things, objects, subjects, personalities, organizations, technologies, are not fixed, free-standing, bounded individualities but dynamic, fluid, emergent, temporally stabilized beings. Being is thus constituted by its process of becoming actuality as, in Whitehead's words, "[t]he actual entities ... make real what was antecedently merely potential" [37] (p. 72). This implies, as Introna notes, that:

In their actuality all beings are ontologically open (and as such ontologically malleable and emerging) ... no being/entity is ever "complete" so that this complete entity can then have relations with other entities (in such "completed" terms) which are then somehow external to its own constitutive becoming (Whitehead, 1978, p. 59) – becoming is not "between" but always within, and as such, constitutive of actual entities. [26] (pp. 332–333)

Beings are understood as "epiphenomena of primary fluxing and changing patterns of relationships and event clustering" [49] (p. 283). When we experience organizations and technologies as stable and ordered we need to look within, beneath and beyond them to uncover their "becoming" or "occurrence" and how they become accomplished as "impermanent patterns" of ceaseless relational processes.

Time in substantialist metaphysics is taken to be universal, absolute and objective as is postulated in Newtonian physics. Time measures movement and events in space. Time runs uniformly, in a linear fashion and can be divided into discrete units. "Clock-time" is measured precisely according the World Standard Time.<sup>2</sup>

In process metaphysics time is intimately linked to processes. The flow of process cannot be separated from the flow of time. Developments in physics in the early 20th century, and in particular Einstein's theory of relativity, revealed that measuring time is relative to a reference system and cannot thus be absolute [50]. Process thinkers together with contemporary physicists:

reject the Newtonian view that time and space exist as some fixed background or framework separate from the events that happen within them as if time and space form the bottle around us that would still exist even if all events disappeared. Time simply is the passage – the becoming and perishing – of events. [33] (p. 43)

Drawing from Einstein, Bergson conceptualized time as "experienced time", a "real time", a lived "durée" as part of the flow from past into future. For Bergson, the real time duration is different from linear, "measured time": "Our duration is not merely one instant replacing another; if it were, there would never be anything but

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<sup>2</sup> The World Standard Time agreed 1 October 1884 included 24 time zones and Greenwich as the zero meridian [50].

present – no prolonging of the past into the actual, no evolution, no concrete duration. Duration is the continuous progress of the past which gnaws into future and swells as it advances ...” [51] (p. 4). The dynamicity of our experience implies its own time, the past (memory) that lives in the present as it is becoming (creating) a future. In process metaphysics time is of central importance for appreciating and dwelling in processes.

## **4 Reflections on Substantialist Metaphysics Underlying IS Research and the Shifts Towards Process Metaphysics**

### **4.1 IS Research Underlined by Substantialist Metaphysics**

From its beginning the Information Systems discipline eagerly embraced substantialist metaphysics following other business disciplines seeking legitimacy of a proper scientific discipline [52]. IS research in the 1970s and 1980s was motivated by the development and deployment of IT in organizations and the increasingly evident implications on employees, quality of work, decision making processes, productivity, efficiency and effectiveness, organizational performance and power and organizational structures, e.g. [53, 54]. IS researchers tended to adopt a positivist research paradigm, assuming that the world consists of discrete entities – human beings, organizations, technologies, processes, products, accounts and others – that exist independently of observers [8]. These entities are characterized by inherent and largely stable properties and relationships that can be unproblematically studied, measured and mapped. The aim of research was to discover causal relations among phenomena of interest so that they can be explained and predicted. Researchers thus developed research models that define constructs (variables) to represent (and measure) relevant entities and hypothesized relations among the constructs (assuming one-to-one correspondence with the real world). For example, the technology acceptance model defined two variables, “perceived usefulness” and “perceived ease of use”, which are causally related as fundamental determinants to the variable “user acceptance of technology” [55]. The research models are then empirically tested in order to either verify or falsify the hypothesized causal relations, following the hypothetic-deductive account of scientific explanation.

Of particular interest to positivist research is how information systems and information technologies (IS/IT) as an autonomous, exogenous force impact on organizational processes and structures [17]. This view of IT/IS was based on the assumption that “[a]n information system is an artefactual *representation* of a real-world system as perceived by someone, built to perform information processing functions” [56] (p. 62, emphasis in original). While positivist IS researchers widely assumed such a view they rarely expressed explicitly their ontological assumptions. A notable exception is found in Weber [57] where fundamental ontological concepts and their derivatives are defined (based on Bunge’s [58] generalized ontology) as a foundation for the evaluation of IS theories [57] (p. 3):

- The world is made of things. Things can be substantial or concrete (e.g., an information system user or a computer); alternatively, they can be conceptual (e.g., a mathematical set of a function). ...
- All concrete things in the world possess properties ... Similarly, all properties in the world attach to some thing ... For example, a human (a concrete thing) may possess a property that he uses an information system, and a computer (a concrete thing) has a property of possessing a certain amount of internal memory. ...
- The way in which we perceive a property at a point in time (our representation of it) is called an attribute. Various types of attributes exist ...
- A vector of attributes in particular represents a state of a thing (its attributes in general along with their associated values). ...
- An event that a thing undergoes is represented by a change from one of its states to another of its states (at least one of its attributes change values). ...
- The history of a thing is a sequence (ordered set) of its states (e.g., the states that a thing traverses over time are ordered by time). ...
- Two things interact when the history of one thing is not independent of the history of the other thing. ...

These concepts represent a paradigmatic case of substantialist metaphysics that has underpinned much of mainstream IS research since its early days (although not necessarily articulated so precisely and exhaustively). In Weber's ontology reality consists of things characterized by attributes and states, and also events when things change their states. Such a view of events is consistent with the substantialist metaphysics' reductionist view of process – an event is defined as the change of a thing's state.

By defining what exists in the world, metaphysics also circumscribes what is studied, what is considered credible evidence and how justifiable knowledge is generated. Substantialist metaphysics provided the foundation to study information systems, information technologies, individuals and organizations as discrete, self-contained, describable entities represented as variables allowing for empirical testing of nomological statements about their behaviour – cause and effect relationships among variables, representing objectively what is the case in the world. For instance Daft and Lengel's, Media Richness Theory [59] posited that communication media affect users' ability to communicate and change understanding. IS/IT in these studies are often presented as causal determinants of organizational change [17]. Grounded in substantialist metaphysics and representationalist epistemology positivist research exemplified the scientific ideal to study and objectively establish IS/IT effects across time and space, independently of their particular use in any concrete social setting [56,] [60].

While the positivist paradigm dominated and continues to dominate mainstream IS research, it has been subjected to critique and its limitations have been debated from various perspectives. The key issue is the disregard of social and historical conditions and contexts of IS development and use, which limits the understanding of these pro-

cesses and their effects. Assuming one-dimensional causal relationships among IS/IT and human and organizational effects, many positivist studies adopt a form of *technological determinism* [18], [61]. Positivist studies test predefined relations among variables and thus are not “conducive to the discovery and understanding of non-deterministic and reciprocal relationships” [8] (pp. 12–13). Furthermore, by abstracting to variables and across contexts, positivist studies, Ramiller and Pentland argue, remove participants’ meanings, history and also content (actors, actions and artifacts) which as a result disconnect research results from practice [62].

#### 4.2 A Shift Towards an Interpretive Approach and Social Constructivism

During the 1980s and 1990s significant attempts were made to overcome the limitations of the positivist approach by focusing on social contexts in which IS/IT are developed, deployed and used and in which they are interpreted and enacted thus becoming part of social and political dynamics [12], [18]. The interpretive approach, boosted by the Manchester 1984 Conference [9], introduced new views on information systems and organizing within complex social and historical contexts that departed from substantialist metaphysics and technological determinism.<sup>3</sup> The interpretive research approach assumed the subjective and socially constructed nature of IS/IT and organizations and the emerging processes of their mutual shaping and co-construction. Interpretive researchers thus believe that a relevant reality cannot be isolated and measured in an “objective” way and independently of researchers, but instead argue that reality is always interpreted (by people studied and by researchers) in a value-laden and subjective manner.

Kling and Scacchi for example proposed the web ontology of computing that explains how computers became enmeshed in webs of social relationships by making explicit the “salient connections between a focal technology and its social and political context” that help understand “the dynamics of computing development and use in organizational life” [66] (p. 3). Markus [67] examined the organizational power and politics and how they become implicated in the dynamics of MIS implementation. Another example of the social constructivist view concerns studies on IS project success or failure. Assuming interpretive flexibility of IS projects, their success or failure is not seen as an objectively existing end state, but instead is considered to exist only as an interpretation or construction by relevant social groups, see e.g. [68].

A distinct stream of interpretive research has been informed by Giddens’ theory of structuration [69] that transcends the subjective/objective polarization of social reality [12]. Drawing on Giddens’ theory, Orlikowski proposed a “structuration model of technology” that allows a “dialectic understanding of interaction between technology and organization” [70] (p. 398). The model assumes “interpretive flexibility of technology” that refers to the “degree to which users of a technology are engaged in its

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<sup>3</sup> This was part of a larger, often called reformist movement of qualitative research and the adoption of interpretive philosophies in social sciences that began in the 1970s as a reaction to positivist social science [63, 64, 65].

constitution (physically and/or socially) during development or use” [70] (p. 409), thus depending on the technology, human agents and the context.

Interpretive research opened up new ways of thinking about, investigating and theorizing complex questions of IS/IT and organizing. It made distinct contributions to understanding the transformational processes involved in technology deployment and the subjective, local and contextual meaning of technologically mediated work and managing practices. For instance, Walsham, one of the prominent champions of interpretivism in IS, articulated the new metaphysics of information systems and organizing:

Computer-based information systems embody interpretive schemes in the sense that they provide ways of viewing the world and thus making sense of it. They also reflect norms and values concerning what are desirable states of the world or what can be achieved. Finally they provide a facility that can be used in the control and coordination of material and human resources. [71] (p. 235)

Computer-based information systems may thus be associated with elements of changed social structures, but its use can also reproduce existing structures of meaning, power and morality; or, in other words [they] are associated with a blend of social reproduction and change. ... Important elements of change ... include new forms of work activities, new roles and involvement with others, and thus new identities at work for individuals and their perception in the eyes of the others. [71] (p. 236)

To understand an information system, what it is and what it does, we must grasp the interpretive schemes they embody and the ways their use mediates social actors' interpretation, meaning making and actions in organizational contexts. An information system thus does not “mirror” (independently existing) objects from the real world but rather represents a particular interpretation of the real world which in turn participates in the construction of the real (e.g. social reproduction of structures or change, [12], [72]). While information systems are technologically realized their meaning, use and effects in the social context are socially constructed, together with everything else in the social world. The development, implementation and use of information systems and their implications in organizations and society cannot thus be understood independently of social actors, their lifeworlds, meaning systems, cultural and historical backgrounds, and emerging social processes. Interpretive IS research is not aiming to isolate, explain and predict IS phenomena but rather to contribute to the understanding (*Verstehen*) of IS phenomena in practice, see e.g. [8], [17], [23], [71], [73].

Interpretive researchers can be seen as trailblazers that moved away from substantialist metaphysics, seeking new ways of seeing and thinking about reality as socially constructed, and focusing on subjectivity and objectivity, agency and structure, processes and temporality, sociality and materiality. They revealed exciting new possibilities to engage in actual processes of embedding and enacting IS/IT in various social

and organizing contexts and generating knowledge by drawing from human subjectivity while not sacrificing the objectivity of knowledge [65]. However, the interpretive approach faced some significant criticism, often by its key protagonists.

First, interpretive researchers engage and observe reality while aiming to remain objective and external to it. As Schwandt remarks, “in interpretive tradition, the interpreter objectifies (i.e. stand over and against) that which is to be interpreted. And, in this sense, the interpreter remains unaffected by and external to the interpretive process” [65] (p. 194). In addition Latour [74, 75] critiqued social constructivism for privileging human beings and disregarding other heterogeneous agents in performing reality.

Second, interpretive researchers struggled with the plurality of subjective perceptions, interpretations and constructions of reality (e.g. of IS implementation and success) by different social groups. The problem with plurality of interpretations, as Mol [76] and Law [77] extensively discuss, is the assumption of a single underlying reality of which different social groups have different perceptions and interpretations. They instead argue that multiple realities are often enacted and that this is not a question of epistemology but ontology.

And the third objection, expressed by Leonardi and Barley, is that the “swing away from technological determinism toward social constructivism, which began in the 1980s, has gone too far” [12] (p. 3). The key issue I would add following Latour [74] is that social constructivism with its central preoccupation with human perceptions and interpretations has not taken seriously into account participation and contribution by non-human actors in the construction of reality. Most importantly, while social constructivist metaphysics moved away from substantialist metaphysics it has not gone far enough towards adopting and applying process thinking.

### **4.3 A Shift Towards Relational Ontology and a Sociomaterial Approach**

The movement towards relational ontology is contrasted to substantialist metaphysics [78] as well as social constructivism [74, 75]. Relational ontology assumes that humans, technologies and things emerge through relations in practice: they do not pre-exist as entities (with given or interpreted properties and boundaries) but are instead created and continually recreated through relations. The founding assumption is that relations are primary and relata secondary [79, 80]. Everything that exists is thus always in becoming as relational effects. As we can see relational ontology has striking similarities with process metaphysics as their assumptions and orientations clearly overlap. Mesle [33], for instance, explicitly articulated process-relational metaphysics. Shotter [81] draws on relational ontology and Barad [79, 80] among others to explore process orientation in practice. Inrona referring to Bergson and Whitehead, claims that entities with pre-existing quality do not exist in actuality but are the “emergent accomplishments of becoming” [26] (p. 332) through relations that are constitutive of their very beings. However, only a handful of authors recognize metaphysical resemblance among the relational ontology and process metaphysics [26], [47], [81, 82].



The movement inspired by relational ontology involves several parallel streams of research in science and technology studies (STS) and actor-network theory (ANT) in particular, e.g. [75, 76, 77], [83, 84, 85, 86]; feminist and science studies, e.g. [87], [79, 80]; and many others. Drawing from these streams and specifically Barad's agential realism [79, 80] a sociomaterial approach was recently proposed in IS and organization studies [16, 17, 18] [88]. The sociomaterial approach emerged at a particular time when it became increasingly more difficult to disentangle information and communication technologies from work practices, organizing and socializing, public and private lives. It assumes an ever-changing world that is continuously re-constructed and re-assembled out of heterogeneous materials.

One of the founding concepts of the sociomaterial approach is the entanglement of humans and non-humans, the social and the technological (material), that is, heterogeneous actors who continually co-construct reality and at the same time co-constitute each other. Actors are thus actual accomplishments of heterogeneous assemblages. To understand the dynamics of their entanglement Barad proposed the concept of intra-relating and intra-action:

To be entangled is not simply to be intertwined with another, as in the joining of separate entities, but to lack an independent, self-contained existence. Existence is not an individual affair. Individuals do not pre-exist their interactions; rather, individuals emerge through and as part of entangled intra-relating. Which is not to say that emergence happens once for all, as an event or as a process that takes place according to some external measure of space and time, but rather that time and space, like matter and meaning, come into existence, are iteratively reconfigured through each intra-action, thereby making it impossible to differentiate in any absolute sense between creation and renewal, beginning and returning, continuity and discontinuity, here and there, past and future. [80] (p. ix)

The ongoing processes of becoming are thus temporal, based on lived time rather than clock time, a view that features prominently in process metaphysics.

While talking of becoming through relations Barad assumes that all relations are internal to the becoming of actors [80], implying that the actors are never "completed" [26]. They may be stabilized, performed as particular actors with particular properties and relations, by what Barad [80] calls "agential cuts". Agential cuts are local resolutions of ontological openness, implying no authors of the performative outcomes. In Intra's words, "[i]n the ongoing flow of becoming there is no author (or authority) as such. There is no actor 'outside' the heterogeneous assemblage that can intra-act with it and somehow not become implicated in the performative outcome" [26] (p. 338).

The sociomaterial approach, as Orlikowski and Scott [18] emphasize, adopts a posthumanist notion of performativity that decentres the human and "incorporates important material and discursive, social and scientific, human and nonhuman, and natural and cultural factors" [79] (p. 808). By adopting posthumanist performativity

they follow Barad who questions and rejects the notion of agency that is located either in humans or in objects (technologies):

Agency is a matter of intra-acting; it is an enactment, not something that someone or something has. Agency cannot be designated as an attribute of “subjects” or “objects” (as they do not preexist as such). Agency is not an attribute whatsoever – it is “doing”/“being” in its intra-activity. [79] (p. 827)

It is important to note that Orlikowski and Scott proposed the sociomaterial approach as an attempt:

to move beyond the separation of the technical and the social. For researchers [adopting the assumptions of relationality and becoming] practices are always sociomaterial, and this sociomateriality is integral, inherent, and constitutive, shaping the contours and possibilities of everyday organizing. As Barad (2003, p. 818) puts it, “Agencies are not attributes [of either humans or nonhumans] but ongoing reconfigurations of the world.” Thus, an important challenge for research going forward is developing ways of thinking and talking about the social and material worlds as inseparable, as constitutively entangled. [18] (p. 463)

Given its grounding in relational ontology, the hallmark of the sociomaterial approach is ontological inseparability of the social and the technical and their constitutive entanglement – clearly distinguishing the sociomaterial approach from other approaches (in particular the positivist and interpretive).

Early work by Orlikowski [16, 17] and Orlikowski and Scott [18] stimulated a stream of empirical studies that contributed to the sociomaterial scholarship [29], of which I’ll mention only a few.

In an early attempt to adopt a sociomaterial practice perspective [18] Wagner et al. [89] explore the survival of an Enterprise System (ES) project. They conceptualize ES as a sociomaterial assemblage that disturbs the previous sociomaterial assemblage of legacy practices and thus produces resistance at rollout. By exploring the processes of mutual accommodation and adaptation of the social and the technological during the post-rollout phase they demonstrate how resistance is accommodated through sociomaterial adaptations. The authors contribute to changing discourse on ES projects from *best practice* to *negotiated practice*, demonstrating how project survival often depends on sociomaterial adaptations and negotiations well beyond the rollout phase.

The work by Østerlie et al. [20] is another example of sociomaterial scholarship. The authors provide an account of *dual materiality* of the undifferentiated phenomena of well flows in petroleum exploitation (e.g. liquids, gases and sand) and the information system (arrangements of sensors, computer equipment and algorithms) used by the engineers as part of practice. They contribute to the discourse on sociomateriality by “refining ideas of materiality, which has thus far been predominantly limited to

the materiality of technological artifacts. Dual materiality highlights how IS becomes important, as its materiality plays an integral part in creating, not simply representing, the materiality of the physical world” – in their case the well flow [20] (p. 102). The notion of dual materiality, as the authors indicate, is an instance of Barad’s [80] phenomenon-instrumentation relationship.

A sociomaterial ethnography of planetary exploration at NASA (a mission orbiting an outer planet in the solar system) by Mazmanian et al. [90] draws on Barad [79], Haraway [87] and Suchman [88] and explores “how physical, social, material, technological and organizational arrangements dynamically reconfigure each other in the *durée* of organizational practice” [90] (p. 831). They contribute further theorizing of the notion of constitutive entanglement of the social and the technological/material by explaining the dynamic reconfiguration of the people, social structures, information technologies and representational objects in practice.

Based on a comparative study of the UK-based AA hotel evaluation system and online evaluations on TripAdvisor (a form of crowd-sourced content) Scott and Orlikowski [15] explore the phenomenon of anonymity. In contrast to the dominant view on anonymity as a social phenomenon – a static attribute of an agent or a system – they show how anonymity is performed differentially by material-discursive practices of the AA and TripAdvisor evaluations. Drawing from Barad’s agential realism [79, 80] the authors demonstrate that anonymity is an enacted accomplishment of these practices. The authors explain how such enactments of anonymity through specific material-discursive practices generate different agential cuts, that is, a particular hotel ranking by the AA system and the other by TripAdvisor, with serious performative effects in the hospitality sector. This paper has broader implications for understanding the performative effects of openness and (lack of) accountability of social media and crowd-sourced content drawing attention to their emerging consequences in everyday practices of knowledge production and consumption.

The sociomaterial approach, together with other research streams founded on relational ontology, are breaking new grounds in understanding the dynamic, uncertain and technologically impregnated world differently. The move towards the sociomaterial approach, I suggest, signifies a move towards process thinking. While the original proposal for the sociomaterial approach does not explicitly draw from process metaphysics, its foundation in relational ontology is processual in nature. Furthermore, some researchers like Introna [26], [82], [91] and Shotter [81] who engage seamlessly with the relational and the process metaphysics demonstrate their ontological kinship and shared roots.

While the sociomaterial approach has been debated for a about decade, the IS research community is yet to appreciate its distinct nature and novelty and understand the intellectual expansion of research possibilities that it enables. The problem, however, is that the debate on sociomateriality was framed within the dualist worldview and substantialist metaphysics. The radical nature of relational ontology that underpins the sociomaterial approach has been misunderstood, denied or plainly claimed wrong. The debate on sociomateriality has turned into a discussion on the importance

and distinct nature of the material (including technology) and its relation to the social [25], [30]. Sociomaterial accounts are critiqued for their alleged failure to define the material (its “intrinsic properties”) and to explain entanglement, e.g. [25], [30], [92]. The sociomaterial approach is thus questioned and assessed on the grounds of substantialist metaphysics leading to claims that it is a “wrong turning” [27]. It is particularly intriguing that the sociomaterial approach has been critiqued and redefined, precisely based on substantialist metaphysics that it rejects! Kautz and Janson [93] refer to these opposing views as different “camps” and alert the research community to the controversy and confusion emerging in the IS and organization studies debate on sociomateriality.

There are now different conceptions of the sociomaterial approach [93] and the confusion in the literature as to what it is that the term denotes. Conflating different ontological positions has been detrimental to the development of the sociomaterial approach. The key problem of course has been the lack of appreciation and understanding of the relational ontology and processual thinking as well as the radical departure from substantialist metaphysics that the sociomaterial approach exemplified.

While the above exploration is out of necessity limited (omitting numerous authors and works that deserve mention) it shows that the road from substantialist to processual thinking has been a difficult one and that the journey has had many obstacles and distractions. The debates in IS have more often obscured rather than clarified the differences in research approaches and their implications. Grounding our debates in metaphysical assumptions, as I tried to do here, might help IS researchers better understand the paradigmatic differences and controversies and engage in a more constructive dialogue.

## **5 Concluding Remarks**

As the IS discipline experiences shifts from positivist to interpretive to sociomaterial paradigms we are caught up in a long-standing controversy between the substantialist and process metaphysics without recognizing its foundation or understanding its historical roots. The paradigm debates, especially those related to the emergence of interpretivism and the more recent confrontation among the so-called different camps of the sociomaterial approach, have been fought within an intellectual climate largely informed, although not necessarily explicitly, by Burrell and Morgan’s paradigm model [1]. These debates in many respects obscured the deep underlying metaphysical differences and thus led to poorly articulated conflicts and confusing argumentation.

In this paper I propose a different grounding for our paradigm debates: the distinction between substantialist and process metaphysics. By briefly reviewing their historical developments and summarizing their key differentiating assumptions, I offer the conceptual foundation to examine and reflect on paradigm shifts in IS research from positivist to interpretive to sociomaterial. This discussion shows how the proposed metaphysical grounding contributes to the contemporary IS paradigm debate by re-

vealing new insights into differences among research paradigms as well as sources of conflict and confusion.

Substantialist metaphysics has dominated Western thought, languages, education and socialization. We have grown up believing that things have a nature that is fixed and describable and that through our inquiries we are representing this nature ever more accurately and thus usefully. The IS discipline has been built on this tradition and has seen remarkable development grounded in substantialist metaphysics. It is therefore not surprising that departing from substantialist thinking and opening new ways of thinking about, investigating and theorizing complex questions of technologies and organizing have been difficult and often obstructed. Similar to other social sciences, the IS discipline has been struggling to find ways to go beyond substantialist metaphysics and advance research based on alternative worldviews.

It is important to note here that while the choice of a paradigm can be more or less compellingly argued it cannot be scientifically justified based on some fundamental assumptions and evaluative standards as these very assumptions and standards characterize the paradigm in question. “In paradigm choice – Kuhn contends – there is no standard higher than the assent of the relevant community” [5] (p. 94). When one group “uses its own paradigm to argue in that paradigm’s defense” [5] (p. 94) it uses a circular argument. To advance the paradigm debate further we need to explicate and reflect on metaphysical assumptions and argue for a novel paradigm based on its ability to identify and deal with relevant phenomena. This becomes particularly important when a new metaphysics is proposed that challenges the dominant, widely accepted one, due to inevitable misunderstandings and the risk of dismissing research contributions founded on unknown and unaccepted set of assumptions.

While a paradigm choice cannot be scientifically justified (or proven right or wrong), it can nevertheless be clearly explained and persuasively argued for. The metaphysical grounding of the paradigm debate can help advance scholarly communication and nurture critical discourse. Explicitly reflecting on metaphysics and confronting different philosophical foundations of our research might actually be revealing and act like a *gestalt switch* to help us open up new ways of looking at and seeing the world.

## References

1. Burrell, G., Morgan, G.: Sociological Paradigms and Organizational Analysis. Heinemann, London (1979)
2. van Inwagen, P., Meghan, S.: Metaphysics. The Stanford Encyclopedia of Philosophy (Spring 2016 Edition), Edward N. Zalta (ed.). Available at: <http://plato.stanford.edu/archives/spr2016/entries/metaphysics/> (accessed 04.10.2016)
3. Wikipedia contributors: Metaphysics, Wikipedia, The Free Encyclopedia. Available at: <https://en.wikipedia.org/w/index.php?title=Metaphysics&oldid=730339837> (accessed 16.08.2016)
4. Rescher, N.: Process Metaphysics. SUNY Press, New York (1996)

5. Kuhn, T.: *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago (1962/96)
6. Ritzer, G. (ed.): *Methateorizing*. Sage, London (1992)
7. Deetz, S.: Describing Differences in Approaches to Organization Science: Rethinking Burrell and Morgan and Their Legacy. *Organization Science*. 7(2), 191–207 (1996)
8. Orlikowski, W.J., Baroudi, J.J.: Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*. 2(1), 1–28 (1991)
9. Fitzgerald, G., Hirschheim, R., Mumford, E., Wood-Harper, A.T. (eds): *Research Methods in Information Systems*. Elsevier Science Publishers, Amsterdam (1985)
10. Chen, W.S., Hirschheim, R.: A Paradigmatic and Methodological Examination of Information Systems Research from 1991 to 2001. *Information Systems Journal*. 14(3), 197–235 (2004)
11. Lyytinen, K., Yoo, Y.: Issues and Challenges in Ubiquitous Computing. *Communications of the ACM*. 45(12), 63–65 (2002)
12. Leonardi, P.M., Barley, S.R.: What's Under Construction Here? Social Action, Materiality, and Power in Constructivist Studies of Technology and Organizing. *The Academy of Management Annals*. 4(1), 1–51 (2010)
13. Yoo, Y.: Computing in Everyday Life: A Call for Research on Experiential Computing. *MIS Quarterly*. 34(2), 213–231 (2010)
14. Yoo, Y., Boland, R.J., Lyytinen, K., Majchrzak, A.: Organizing for Innovation in Digitalized World. *Organization Science*. 23(5), 1398–1408 (2012)
15. Scott, V.S., Orlikowski, J.W.: Entanglements in Practice: Performing Anonymity through Social Media. *MIS Quarterly*. 38(3), 873–893 (2014)
16. Orlikowski, W.J.: Sociomaterial Practices: Exploring Technology at Work. *Organization Studies*. 28(9), 1435–1448 (2007)
17. Orlikowski, W.J.: The Sociomateriality of Organizational Life: Considering Technology in Management Research. *Cambridge Journal of Economics*. 34(1), 125–141 (2010)
18. Orlikowski, W.J., Scott, S.V.: Sociomateriality: Challenging the Separation of Technology, Work and Organization. *The Academy of Management Annals*. 2(1), 433–474 (2008)
19. Leonardi, P.M., Nardi B.A., Kallinikos, J. (eds): *Materiality and Organizing: Social Interaction in a Technological World*. Oxford University Press, Oxford (2012).
20. Østerlie, T., Almklov, P.G., Hepsø, V.: Dual Materiality and Knowing in Petroleum Production. *Information and Organization*. 22(2), 85–105 (2012)
21. Mingers, J., Mutch, A., Willcocks, L.: Critical Realism in Information Systems Research. *MIS Quarterly*. 37(3), 795–802 (2013)
22. Almklov, P.G., Østerlie, T., Haavik, T.K.: Situated with Infrastructures: Interactivity and Entanglement in Sensor Data Interpretation. *Journal of Association of Information Systems*. (15), 263–286 (2014)
23. Klein, H.K., Myers, M.D.: A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly*. 23(1), 67–94 (1999)
24. Sarker, S., Xiao, X., Baulieu, T.: Qualitative Studies in Information Systems: A Critical Review and Some Guiding Principles. *MIS Quarterly*. 37(4), iii–xviii (2013)
25. Leonardi, P.M.: Materiality, Sociomateriality, and Socio-Technical Systems: What Do These Terms Mean? How Are They Different? In: Leonardi, P.M., Nardi B.A., Kallinikos, J. (eds) *Materiality and Organizing: Social Interaction in a Technological World*, pp. 25–48. Oxford University Press, Oxford (2012)
26. Introna, L.: Epilogue: Performativity and the Becoming of Sociomaterial Assemblages. In: de Vaujany, F.-X., Mitev, N. (eds) *Materiality and Space: Organizations, Artefacts and Practice*, pp. 330–342. Palgrave Macmillan, Basingstoke (2013)

27. Mutch, A.: Sociomateriality: Taking the Wrong Turning? *Information and Organization*. (23), 28–40 (2013)
28. Orlikowski, W.J., Scott, V.S.: Knowledge Eclipse: Producing Sociomaterial Reconfigurations in the Hospitality Sector. In: Carlile, P.R., Nicolini, D., Langley, A., Tsoukas, H. (eds) *How Matter Matters: Objects, Artifacts, and Materiality in Organization Studies*, pp. 119–141. Oxford University Press, London (2013)
29. Cecez-Kecmanovic, D., Galliers, R.D., Henfridsson, O., Newell, S., Vidgen, R.: The Sociomateriality of Information Systems: Current Status, Future Directions. *MIS Quarterly*. 38(3), 809–830 (2014)
30. Leonardi, P.M.: Theoretical Foundations for the Study of Sociomateriality. *Information and Organization*. (23), 59–76 (2013)
31. Cunliffe, A.: Crafting Qualitative Research: Morgan and Smircich 30 Years on. *Organizational Research Methods*. (14), 647–673 (2011)
32. Graham, D.: Heraclitus as a Process Philosopher. *Philosophy Study*. 2(1), 1–8 (2012)
33. Mesle, C.R.: *Process-Relational Philosophy: An Introduction to Alfred North Whitehead*. Templeton Press, West Conshohocken, PA (2008)
34. Seibt, J.: Process Philosophy. *The Stanford Encyclopaedia of Philosophy* (Spring 2016 Edition). Available at: <http://plato.stanford.edu/archives/spr2016/entries/process-philosophy/> (accessed 04.10.2016)
35. Plato: *Timaeus and Critias*. Penguin, London (2008)
36. Cohen, S.M.: Aristotle's *Metaphysic*. *The Stamford Encyclopaedia of Philosophy* (2012). Available at: <http://plato.stanford.edu/entries/aristotle-metaphysics/> (accessed 04.10.2016)
37. Whitehead, A.N.: *Process and Reality* (ed. Griffin D.R., Sherburne D.W.). The Free Press, New York (1978)
38. Hernes, T.: Alfred North Whitehead (1861–1947). In: Helin, J., Hernes, T., Hjorth, D. and Holt, R. (eds) *The Oxford Handbook of Process Philosophy and Organization Studies*. Oxford Handbooks Online (2014)
39. Dewey, J., Bentley, A.: *Knowing and the Known*. In: Boydston, J.A. (ed.) *Later Works 16*, pp. 1–294. Southern Illinois University Press, Carbondale and Edwardsville (1989)
40. Dewey, J.: *Experience and Nature*. In Boydston, J.A. (ed.) *Later Works 1*, pp. 1–326. Southern Illinois University Press, Carbondale and Edwardsville (1981)
41. Bergson, H.: *Time and Free Will: An Essay on the Immediate Data of Consciousness*. Routledge, London (1910)
42. Linstead, S.: Henri Bergson (1859–1941). In: Helin, J., Hernes, T., Hjorth, D., Holt, R. (eds.) *The Oxford Handbook of Process Philosophy and Organization Studies*. Oxford Handbooks Online (2014)
43. Rescher, N.: *Process Philosophy: A Survey of Basic Issues*. University of Pittsburgh Press, Pittsburgh, PA (2000)
44. Helin, J., Hernes, T., Hjorth, D., Holt, R.: *Process Is How Process Does*. In: Helin, J., Hernes, T., Hjorth, D., Holt, R. (eds.) *The Oxford Handbook of Process Philosophy and Organization Studies*. Oxford Handbooks Online (2014)
45. Descartes, R.: *Philosophical Works of Descartes* (Trans. E. Haldane, G.R.T. Ross). Dover Publishing, New York (1931)
46. Gergen, J.K.: *Relational Being: Beyond Self and Community*. Oxford University Press, Oxford (2009)
47. Gergen, J.K.: *Co-Constitution, Causality, and Confluence: Organizing in a World Without Entities*. In : Hernes, T., Maitlis, S. (eds) *Process, Sensemaking, and Organizing*, pp. 55–69. Oxford University Press, Oxford (2010)

48. Rescher, N.: *Process Philosophy*, The Stanford Encyclopaedia of Philosophy (Summer 2012 Edition). Available at: <http://plato.stanford.edu/archives/sum2012/entries/process-philosophy/> (accessed 04.10.2016)
49. Nayak, A., Chia, R.: *Thinking Becoming and Emergence: Process Philosophy and Organization Studies*. *Philosophy and Organization Theory Research in the Sociology of Organizations*. 32, 281–309 (2011)
50. Chia, R.: *Essay: Time, Duration and Simultaneity: Rethinking Process and Change in Organization Analysis*. *Organization Studies*. 23(6), 863–868 (2002)
51. Bergson, H.: *Creative Evolution*. Dover, Mineola, NY (1998).
52. Klein, H.K., Welke, R.J.: *Information Systems as a Scientific Discipline*. Proc. Administrative Services Association Conference, pp. 106–116. University of Ottawa, Ottawa (1982)
53. Attewell, P., Rule, J.: *Computing and Organizations: What We Know and What We Don't Know*. *Communications of the ACM*. 27(12), 1184–1192 (1984)
54. Malone, T.W., Yates, J., Benjamin, R.I.: *Electronic Markets and Electronic Hierarchies*. *Communications of the ACM*. 30(6), 484–497 (1987)
55. Davis, F.D.: *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology*. *MIS Quarterly*. 13(3), 319–340 (1989)
56. Wand, Y., Weber, R.: *Toward a Theory of the Deep Structure of Information Systems*. In: De Gross, J.I., Alavi, M., Oppelland, H. (eds) *ICIS 1990 Proceedings*, Copenhagen, pp. 61–71. ACM Press, New York (1990)
57. Weber, R.: *Evaluating and Developing Theories in the Information Systems Discipline*. *Journal of the Association for Information Systems*. 13(1), Article 2 (2012)  
Available at: <http://aisel.aisnet.org/jais/vol13/iss1/2> (accessed 04.10.2016)
58. Bunge, M.: *Treatise on Basic Philosophy: Volume 3: Ontology I: The Furniture of the World*. D. Reidel Publishing Company, Dordrecht, Holland (1977)
59. Daft, R.L., Lengel, R.H.: *Organizational Information Requirements, Media Richness and Structural Design*. *Management Science*. 32(5), 554–71(1986)
60. Wand, Y., Weber, R.: *On the Deep Structure of Information Systems*. *Information Systems Journal*. 5(3), 203–223 (1995)
61. Marcus, M.L., Robey, D.: *Information Technology and Organizational Change: Causal Structure in Theory and Research*. *Management Science*. 34(5), 583–598 (1988)
62. Ramiller, N.C., Pentland, B.T.: *Management Implications in Information Systems Research: The Untold Story*. *Journal of Association for Information Systems*. 10(6), 447–494 (2009)
63. Denzin, N.K., Lincoln, Y.S. (eds): *Handbook of Qualitative Research*, 3<sup>rd</sup> edn. Sage, Thousand Oaks (2000)
64. Denzin, N.K., Lincoln, Y.S. (eds): *The Sage Handbook of Qualitative Research*, 2<sup>nd</sup> edn. Sage, Thousand Oaks (2005)
65. Schwandt, T.A. *Three Epistemological Stances for Qualitative Inquiry: Interpretivism, Hermeneutics, and Social Constructivism*. In: Denzin, N.K. and Lincoln, Y.S. (eds) *Handbook of Qualitative Research*, 3<sup>rd</sup> edn, pp. 189–214. Sage, Thousand Oaks (2000)
66. Kling, R., Scacchi, W.: *The Web of Computing: Computer Technology as Social Organization*. *Advances in Computers*. (21), 1–90 (1982)
67. Markus, M.L.: *Power, Politics and MIS Implementation*. *Communication of the ACM*. 26(6), 430–444 (1983)
68. Dougherty, D., Borrelli, L., Munir, K., O'Sullivan, A.: *The Interpretive Flexibility of an Organization's Technology as a Dynamic Capability*. *Advances in Strategic Management*. 15, 169–204 (1998)



69. Giddens, A.: *The Constitution of Society: Outline of the Theory of Structuration*. University of California Press, Berkeley and Los Angeles (1984)
70. Orlikowski, W.J.: Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science*. 3(3), 398–427 (1992)
71. Walsham, G.: *Interpreting Information Systems in Organizations*. John Wiley & Sons, Chichester (1993)
72. Leonardi, P.M., Barley, S.R.: Materiality and Change: Challenges to Building Better Theory about Technology and Organizing. *Information and Organization*. (18), 159–176 (2008)
73. Walsham, G.: Interpretive Case Studies in IS Research: Nature and Method. *European Journal of Information Systems*. (4), 74–81 (1995)
74. Latour, B.: The Promises of Constructivism. In: Ihde, D., Selinger, E. (eds), *Chasing Technoscience: Matrix for Materiality*, pp. 27–46. Indiana University Press, Bloomington (2003)
75. Latour, B.: *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press, Oxford (2005)
76. Mol, A.: Ontological Politics. A Word and Some Questions. In: Law, J., Hassard, J. (eds) *Actor Network Theory and After*, pp. 74–89. Blackwell and the Sociological Review, Oxford and Keele (1999)
77. Law, J.: *After Method: Mess in Social Science Research*. Routledge, London (2004)
78. Emirbayer, M.: Manifesto for a Relational Sociology. *American Journal of Sociology*. 103(2), 281–317 (1997)
79. Barad, K.: Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter. *Signs: Journal of Women in Culture and Society*. 28(3), 801–831 (2003)
80. Barad, K.: *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press, Durham, NC (2007)
81. Shotter, J.: Understanding Process From Within: An Argument for “Witness”-Thinking. *Organization Studies*. 27(4), 585–604 (2006)
82. Introna, L.D.: Maintaining the Reversibility of Foldings: Making the Ethics (Politics) of Information Technology Visible. *Ethics and Information Technology*. 9, 11–25 (2007)
83. Callon, M.: The Sociology of an Actor-Network: The Case of the Electric Vehicle. In: Callon, M., Law, J., Rip A. (eds) *Mapping the Dynamics of Science and Technology*, pp. 19–34. Macmillan Press, London (1986)
84. Law, J.: On STS and Sociology. *The Sociological Review*. 56(4), 623–649 (2008)
85. Law, J.: Actor-Network Theory and Material Semiotics. In: Turner, B.S. (ed.) *The New Blackwell Companion to Social Theory*, 3rd edn, pp. 141–158. Blackwell Publishing, Oxford, UK (2008)
86. Mol, A.: *The Body Multiple: Ontology in Medical Practice*. Duke University Press, Durham, NC (2002)
87. Haraway, D.: A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century. In: *Simians, Cyborgs and Women: The Reinvention of Nature*, pp. 149–181. Routledge, New York (1991)
88. Suchman, L.A.: *Human-Machine Reconfigurations: Plans and Situated Actions*, 2nd edn. Cambridge University Press, Cambridge (2007)
89. Wagner, E.L., Newell, S.M., Piccoli, G.: Understanding Project Survival in an ES Environment: A Sociomaterial Practice Perspective. *Journal of the Association for Information Systems*. 11(5), 276–298 (2010)
90. Mazmanian, M., Cohn, M., Dourish, P.: Dynamic Reconfiguration in Planetary Exploration: A Sociomaterial Ethnography. *MIS Quarterly*. 38(3), 831–848 (2014)

91. Introna, L.D.: Towards a Post-Human Intra-Actional Account of Sociotechnical Agency (and Morality). The Moral Agency and Technical Artefacts Scientific Workshop, NIAS, The Hague (2007)
92. Faulkner, P., Runde, J.: On Sociomateriality. In: Leonardi, P.M., Nardi B.A., Kallinikos, J. (eds) *Materiality and Organizing: Social Interaction in a Technological World*, pp. 49–66. Oxford University Press, Oxford (2012)
93. Kautz, K., Jensen, B.: Sociomateriality at the Royal Court of IS: A Jester’s Monologue. *Information and Organization*. (23), 15–27 (2013)