5-2-2012

CONCEPTUALIZING INFORMATION SYSTEMS: FROM 'INPUT-PROCESSING-OUTPUT' DEVICES TO SOCIOMATERIAL APPARATUSES

Sebastian Boell
University of New South Wales

Dubravka Cecez-Kecmanov
University of New South Wales

CONCEPTUALIZING INFORMATION SYSTEMS: FROM 'INPUT-PROCESSING-OUTPUT' DEVICES TO SOCIOMATERIAL APPARATUSES

Boell, Sebastian, University of New South Wales, Australian School of Business, ISTM, Quad Bldg L2, r. 2952 Sydney 2052, Australia, Sebastian.Boell@unsw.edu.au

Cecez-Kecmanovic, Dubravka, University of New South Wales, Australian School of Business, ISTM, Quad Bldg L2, r. 2101, Sydney 2052, Australia, dubravka@unsw.edu.au

Abstract

This paper examines the concepts of Information System (IS) – central to the IS discipline – with the aim to contribute to the debate on the nature of the concept and stimulate broader engagement of the IS community. To achieve this aim the paper identifies and critically examines common place conceptions of IS in the literature and also those most explicitly and clearly presented in IS textbooks.. IS are commonly seen as devices that represent reality by collecting and processing data and thereby producing information. Such a model of IS as an 'input-processing-output' device that represents reality is grounded in a representational philosophy. Based on a critical assessment of the representational view of information and IS the paper puts forward an alternative performative view founded on agential realism (Barad, 2007). According to this view any observation of the world is mediated by devices, that is, grounded in particular interactions with and translations of the world through devices, which therefore form an integrative part of observed phenomena. Following the performative view, the paper proposes and articulates a new concept of IS as 'apparatus' defined as sociotechnical entanglement of IT artefact, work practices, users, and developers. Theoretical and practical implications of understanding IS as apparatuses are discussed.

Keywords: information systems, IS concepts, IS definitions, sociomateriality, apparatus, performativity, representationalism, intra-action.

1 Introduction

Information and *information systems* (IS) are central concepts in the Information Systems discipline. Their theoretical explorations and debates should, one would expect, be high on the IS researchers' agenda. However, as Lee (2010) recently reminded us, the concepts of information and systems are often taken for granted and rarely seriously questioned and debated. As the IS discipline is maturing scholars are warning that our lack of concerns for conceptual foundations – such as the concepts of information and IS – could be detrimental to distinguishing IS from other disciplines and justifying its existence (Hassan, 2011; Lee, 2010). In this paper we focus on the concept of information system with the aim to contribute to the debate on the nature of the concept and stimulate broader IS community engagement.

One of the rare debates about the key concepts was spawned by the claim that in order for the IS discipline to achieve legitimacy it should define its core. Benbasat and Zmud (2003), among others, argue that the fading attention of IS scholars on the Information Technology (IT) artefact slows progress in establishing legitimacy of the discipline. In their view the IT artefact defined as "the application of IT to enable or support some task(s) embedded within a structure that itself is embedded within a context(s)" (Benbasat and Zmud, 2003, p. 186) is in the core of the IS discipline and should therefore be central to IS research. Consequently, other topics, such as studies of tasks, structures and contexts are seen as located at the periphery of the discipline. In response DeSanctis (2003), echoing Brown and Duguid (2000), argue that questions about "practices and communities, organizations and institutions, family and everyday life" are so important for designers and researchers of technology that they "cannot afford to leave such research solely in the hand of those in other disciplines. [...] if IT researchers don't ponder questions at the periphery of the nomological net, we risk building and implementing less than adequate IT!" (p. 369). Moreover, the concerns with IT artefact design are seen as less important than "the ingenuity of its use" (p. 367).

The debate that ensued indicated once more that the concept of IS is not clearly distinguished from the IT artefact and that the view on the IT artefact as a core of the discipline is highly contentious (e.g. DeSanctis, 2003; Lyytinen and King, 2004). Questions regarding the concept of IS and its role in distinguishing the IS discipline are still very much open (Hassan, 2011; Lee, 2010). Better conceptual understanding and clear definitions of IS are not only relevant for IS research; this is perhaps even more relevant for IS practice.

This paper is conceptual in character: it aims to develop a new integrative concept of IS that transcends IT artefact core/anti-core polarization and reflects the necessity to resist fixed boundaries and include the periphery. To achieve this aim the paper first critically examines common conceptualizations of IS in the literature and specifically those in IS textbooks which are more explicit and clearly defined. The predominant conceptualizations of IS is based on the "input-process-output" model according to which data are collected (input), stored and processed in order to produce information (output) for the users. The underlying assumption is that data objectively record events and processes in the real world and that information produced by an IS thus *represent* reality. Such a view of data, information and IS, as we show in section 4, is founded on *representationalism* which has been questioned in both natural and social sciences. We specifically draw attention to its limitations and implications for IS. This leads us to propose an alternative *performative* view of IS as an *apparatus* (in Barad's, 2007, sense) and discuss it in section 5. This view offers a novel understanding of an information system: *by re-presenting reality, an IS enacts it*. This is followed by the discussion about contributions and implications of the performative conception of IS.

2 Background - Conceptualizations of Information Systems

2.1 Research literature

In 2010 Allen Lee wrote about the past and the future of IS research. He argued that to develop further it is important for IS to engage in a continuous reconstructing of the discipline. This re-constructing can be achieved by critically reviewing current conceptualizations of central concepts in IS research. Moreover, Lee argued that one sign of the maturity of conceptualizations in any discipline is how discipline specific understanding of concepts differ from laypersons definitions of terms. One would, therefore, argue that IS has a more elaborate, specialized, and rich understanding of what constitutes an IS. However, often "the term 'system' or 'information system' appears to be interchangeable with 'information technology'," (Lee, 2004, p. 14):

> "Whenever IS researchers and professionals have used the term 'information system,' one could substitute the term 'information technology,' 'computer system,' or simply, 'the computer' where the substitution would often make little or no difference. In retrospect, it is no exaggeration to describe most IS researchers as having used the term 'system' or 'systems' to refer to just about anything that involves electronic information technology." (Lee, 2010, p. 339)

One example of this view is presented by Wand and Weber (1990, 1995) who argue that IS can be studied independently of its use in a particular social setting. "An information system is an object that can be studied in its own right, independently of the way it is developed and deployed in its organizational and social context," (Wand & Weber, 1995, p. 505). This would indeed indicate that the authors are referring to information technology as an object that can be studied independently of its context (similar to Benbasat and Zmud, 2003) and which impacts organizational processes and structures as an autonomous, exogenous force (Orlikowski, 2010). This view of IT/IS – developed in IS and management research throughout 60s-80s – 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" (Wand & Weber, 1990, p.62; emphasis in original). This view has been broadly adopted in IS textbooks (discussed below) and has thus influenced practice via education.

Research that adopted the view of IT/IS as autonomous and exogenous force has been criticised for its naïve-realist assumptions behind IT/IS; for assuming IT/IS ontologically separate from its human and social contexts, as well as stable and predictable across time and space; and for disregarding human, social and political side of IT/IS development and use (Orlikowski, 2010).

As an alternative to this view on IT/IS, Lee has argued for a perspective that is interested not only in information technology, or social systems, but more specifically at those phenomena that emerge from their interaction (Lee, 2001). An emergent process view argues "that technology results from the ongoing interaction of human choices, actions, social histories and institutional contexts" where technology is "understood as material artifacts that are socially defined and socially produced, and thus relevant only in relation to the people engaging with them" (Orlikowski, 2010, p.132). According to the emergent process view, the design and use of IT/IS are shaped by interests and worldviews of dominant social groups, implying another version of representational assumptions. Specific interpretations embedded in IT/IS or promoted in their use are not claimed to be objective representations of reality but are seen as interest-based, value-laden and subjective representations that ensure desired effects on organizational affairs and performance are achieved (Cecez-Kecmanovic, 2003).

This research approach to and conceptualization of IT/IS has been critiqued for being non-realist and subjective and for privileging social construction of IT artefact at the expense of technological properties and affordances (Orlikowski, 2010). The emergent process view tends to limit understanding of IT/IS role to human interpretation and social construction and thus discourages the recognition of IT/IS agency within these interpretations and constructions.

2.2 IS concepts in textbooks

Another important source for studying conceptualizations of IS are textbooks which typically include much more explicitly defined concepts and models. As Checkland an d Holwell (1998) argue introductory textbooks are most likely to reflect an understanding that is agreed upon in the wider IS community:

> "A good way to find out the conventional wisdom in any field is to see what the introductory university-level student textbooks have to say on the subject. The task of such books it not to draw too much attention to the ambiguities and problems of the field - students will encounter those later - but to provide an account of the field in a straightforward way. Authors of such texts naturally give the account which embodies the more common conceptualisation of the field, the currently conventional view of it." (p. 41-42)

In order to identify the most recent and the most widely adopted perspectives on IS we selected recent editions of textbooks published in 2008 or later and also those that have a track record of acceptance through the publication of multiple editions. The definitions of IS and information from selected textbooks are presented in Table 1.

Definition of Information System	**Definition of Information**
"An information system can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization." (Laudon & Laudon, 2010, p. 46)	"By information we mean data that have been shaped into a form that is meaningful and useful to human beings." (Laudon & Laudon, 2010, p.46)
"Information Systems (1) A set of people, procedures, and resources that collects, transforms, and disseminates information in an organization. (2) A system that accepts data resources as input and processes them into information products and outputs." (O'Brian & Marakas, 2009, p. 631)	"we can define information as data that have been converted into a meaningful and useful context for specific end users." (O'Brian & Marakas, 2009, p. 32)
"An information system (IS) is a set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective." (Moisiadis et al., 2008, p. 3)	"Information is a collection of facts organised in such a way that they have additional value beyond the value of the facts themselves." (Moisiadis et al., 2008, p. 4)
"Management information systems (MIS) deal with the planning for, development, management and use of information technology tools to help people perform all tasks related to information processing and management." (Haag & Cummings, 2008, p. 6)	"Information is data that have a particular meaning within a specific context" (Haag & Cummings, 2008, p. 7)
"A business information system is a group of interrelated components that work collectively to carry out input, processing, output, storage and control interactions in order to convert data into information products that can be used to support forecasting, planning, control, coordination, decision making and operational activities in an organization." (Bocij et al,. 2008, p. 42)	Information is "(a) data that have been processed so that they are meaningful; (b) data that have been processed for a purpose; (c) data that have been interpreted and understood by a recipient." (Bocij et al,. 2008, p. 7)
"Information systems (IS) are combinations of hardware, software, and telecommunications networks that people build and use to collect, create, and distribute useful data, typically in organizational settings." (Jessup & Vlacich, 2008, p. 10)	"Information. Data formatted with dashes or labels is more useful than unformated data. It is transformed into information, which can be defined as a representation of reality." (Jessup & Vlacich, 2008, p. 11)

Table 1. Overview of definitions of 'information systems' and 'information' provided in recent IS textbooks.

Not surprisingly conceptualizations of IS in textbooks show a great degree of agreement between the different textbooks. A closer reading of the definitions listed in Table 1 reveals a common

understanding of IS as devices to *collect* and *disseminate* or *distribute* information[1]. This raises two questions: firstly, what is it that the authors mean by the term 'information'; and secondly, what kind of model is put forward by the authors to describe an IS.

Regarding information, nearly all textbooks define information in relation to data (Table 1). They commonly describe information as processed, shaped, meaningful, or useful data. The same level of agreement can be found regarding the description or model of IS. With the exception of Haag and Cummings (2008) who do not introduce any model for IS, all other authors introduce an 'input-processing-output' model for IS. "An easy way to understand how all information systems work is to use an input, process, and output model – the basic systems model […], which can be used to describe virtually all types of systems," (Jessup and Vlacich, 2008, p. 269). This description of IS is compatible with the approach defining *information as processed data* (Table 1). According to this understanding an IS produces information by processing data. For instance, an accounting IS collects and records transactions and produces numerous financial reports about costs, revenues, taxes, total profits, profit per unit, etc. Importantly, this understanding of IS also assumes that we map reality into databases, knowledge bases, spreadsheets and programs. Textbooks also define various stages of the development process in which system analysts specify entities and their relationships based on the analysis of organizational processes (in case of IS for organizations). Through design IS become devices that provide "a representation of reality," (c.f. definition of information by Jessup and Vlacich, 2008 in Table 1). This is reminiscent of Wand and Weber's conception proposed in 1990.

In addition, most textbooks emphasize that *accuracy* and *completeness* of the representation of reality are key qualities of information requirements specification during an IS development. When data captured by an IS are processed so as to produce information for the users it is assumed that users access a reasonably accurate and complete representation of reality (e.g. information about the actual level of an article in an inventory; accurate current and expected future budget situation; individual or group performance measures). By representing reality IS enable users to act upon the information produced. In other words, IS produce information "to support forecasting, planning, control, coordination, decision making and operational activities in an organization," (Bocij et al., 2008, p. 42). However, the assumptions underlying common definitions and conceptualization of IS can be questioned.

3 A critique of Representationalism

As our brief literature review suggests the dominant conceptions of IS are founded on representationalism – that is an assumption that entities in organizations (e.g. products, employees, documents, accounts) and their representations in IS (in e.g. databases, knowledge bases, spreadsheets, algorithms) are distinct and independent kind of entities. During an analysis phase, for instance, it is assumed that there are entities out there, awaiting representation and when they are 'mapped' into a database they become data. While entities are represented by data structures in an IT artefact, they are distinct and ontologically separate. An import additional assumption is that what is represented in an IS is independent from the sociomaterial practices of representing – interpreting, analysing, selecting, modelling and designing.

Representational thinking is not confined to IS research and practice; it is common in both social and natural sciences – this is where the serious critique of representationalism comes from (Rouse, 1996; Barad, 2003, 2007). Instead of representational approaches Barad (2007) proposes *performative* approaches:

> "Performative approaches call into question representationalism's claims that there are representations, on the one hand, and ontologically separate entities awaiting representation, on the other, and focus inquiry on the practices or performances of representing, as well as the productive effects of those

[1] With the exception of Jessup and Vlacich, 2008 who use the expression 'useful data', which, they then define as information.

> practices and the conditions for their efficacy. A performative understanding for scientific practices, for example, takes account of the fact that knowing does not come from standing at a distance and representing but rather from *a direct material engagement with the world*. Importantly what is at issue is precisely the nature of these enactments. [...] And humans are not the only ones engaged in performative enactments" (p. 49; emphasis in the original)

In IS development the processes and practices of analyzing, interpreting, selecting, modelling and designing are considered neutral and natural (techniques for analysis and design are also discussed in the textbooks) concerned only with the creation of objective or true representations. Performative understanding of IS development, on the other hand, points precisely to these processes and practices as 'performances of representing'. Far from being neutral and natural these processes and practices are performative, that is, they not only *represent* but also *perform* reality. How this is done is an important question.

In case of IS development we are talking about the analysis and design practices in which analysts, designers, different technologies, methodologies, documents, users and various organizational processes and practices get engaged and entangled to produce an IT artefact. Such engagement is performative as it re-presents reality: selects and 'models' the *relevant* entities (actors, objects, things, work processes), their attributes and relationships and excludes others as *irrelevant*. The process of re-presenting does not just map what is out there, but inevitably reduces complex reality to manageable forms (models) and data structures. In other words, reality is *translated* into an IT artefact design. The IT artefact design also often sophisticated data processing and calculations based on which it produces reports, graphs and other outcomes (potential information) assumed to be of interest for the future users. These outcomes are typically instantiated and adapted to the actual users during system implementation. Through analysis and design IS developers produce an IT artefact, which, by re-presenting reality, translates it into a different form (data structures and algorithms). The translation, as Latour (2005) reminds us, is always transformation. Hence, an IT artefact necessarily inscribes a particular view of reality (business process, financial accounting, organizational performance), which becomes enacted (real) once the IT artefact is instantiated and used (discussed below).

While the space does not allow further elaboration, the above discussion suggests that an IT artefact does not just re-present organizational reality but also *enacts* a particular reality. What is of interest here are the practices of representing and their productive effects. For instance, if knowledge workers' performance is measured and represented in an IS as 'hours spent with clients' (excluding training, collection of information about a client, knowledge sharing, relationships building, etc.) the IS does not just represent 'working hours' of knowledge workers; by representing it in a particular way the IS transforms the notion and meaning of 'work'. This has implications for business processes, identity of knowledge workers and the measurement of productivity (Cecez-Kecmanovic, 2003).

This brief critique of representationalism in conceptualizing IS indicates that its key assumptions are problematic, preventing us from exploring more productive and promising views. Instead of representational we propose here a performative view of IS that gives us a chance to better understand and conceptualize a sociomaterial (or 'sociotechnical' without a hyphen) nature of IS (including IT artefacts).

4 Conceptualizing IS as apparatuses

> "A white sheet of paper is not just the necessary background condition for the occurrence of a black dot as a datum, it is a constitutive part of the datum itself," (Floridi, 2004, p. 43).

An alternative way for understanding IS is provided by Barad's notion of apparatus (Barad, 2003, 2007). Barad introduces in her work the idea of *agential realism* which rejects both positions put forward by naïve realism as well as anti-realist stances (Musgrave, 1985; Van Fraassen, 1980). Notably her position also differs from alternative approaches offered by critical realism (Mingers, 2004) or structural realism (Worrall, 1989). Succinctly put Barad showed that any perception, observation, measure, etc. of the world is based on interaction. Moreover, interactions require devices

that allow us to undertake these perceptions, observations, or measurements. And finally, drawing from examples in biology and quantum physics, Barad shows that the devices that are used and the circumstances in which they are used, affect the outcome of this interactions. Even more, perceptions, observations, and measurements become meaningless if they are divorced from the devices and circumstances that create them. Applied to IS any description of reality is mediated by and cannot be disconnected from the devices used to arrive at this description. Barad calls this unity of devices and the whole background on which they make sense 'apparatuses', and introduces the term intra-action to emphasize the co-constitution of the devices of observation and the observed.

In Barad's words apparatuses are phenomena and

> "not mere instruments serving as a system of lenses that magnify and focus our attention on the objective world, rather they are laborers that help constitute and are an integral part of the phenomena being investigated [represented]. Furthermore, apparatuses do not simply detect differences that are already in place; rather they contribute to the production and reconfiguration of differences" (Barad, 2007, p. 232).

If we do not take proper account of entanglements in practices through which an IT artefact is created and then instantiated and used in practice we cannot understand the performative effects of IS as apparatuses in the construction of practice and organizational and social reality. Disregarding the performative nature of IS seriously compromises our understanding of IS and their implications in practice.

An important part of IS as an apparatus is the IT artefact. Any IT artefact is an assemblage of tightly coupled heterogeneous components – hardware components, software components and data structures – designed to accomplish a set of specifications (including information requirements), developed through analysis of work practices and business processes. Data structures include signs that are related to entities, their attributes, events and calculations that have meanings in the organizational context. Selection of *relevant* entities and their attributes and relationships as well as exclusion of others depend on views and interests of project owners (or more precisely those in charge of managing organizations). The IT artefact design thus embodies a particular view of organizational processes that typically serves dominant interests (often those of managers).

When an IS is implemented through the IT artefact instantiation and use the inscribed worldview gets enacted. This enactment is not a simple in-print but a form of translation performed by users, designers, IT artefact and work practices involved. The potential information (intended by the designers) gets transformed into actual information through users' interpretation within their context and background knowledge. The IS (implying entangled users, designers, IT artefact and work practices) thus cannot be seen as only representing reality; the IS becomes an integral part (an actor) in the creation of reality. In other words an IS is a particular apparatus that is sensitive to some phenomena and also (re)produces other phenomena. IS and reality are co-producing each other. Information thus cannot be understood independently from an apparatus (IS) creating it. IS are creating information as reality and not information about reality to use Borgmann's (1999) distinction.

According to Barad's agential realism perceiving information independently from the 'apparatus' that is used to create it makes no sense as particular information can only occur with the use of this apparatus in a particular context. For instance, information about a surplus or deficit in an organization budget cannot be understood outside the accounting IS (and its calculative processes) that produced it. The IS as an apparatus produces a particular reality of budget deficit or surplus by adding, subtracting and valuing different assets in a particular way.

The desired representation of reality in an IT artefact is designed in the sociomaterial practices of designers, which are different in case of in-house developed IT artefact and IT artefact developed by an IT company as packaged software. If we take for example a case of in-house development, an IT artefact design for specific organizational practices results from sociomaterial entanglement of developers, various technologies, organizational processes and procedures, selected managers and other expected users. Such entanglement is typically complex and may be socially and politically sensitive. It is quite common that an IT artefact inscribes the desired nature and form of organizing,

work practices, role of actors, processes and procedures, performance measures and objectives, etc. The design thus often involves re-constitution of all the actors (human and non-human). A designed IT artefact is considered successful when it is seen as capable of enacting the reality it describes while serving potential users by producing specified information.

When the IT artefact is instantiated, implemented and used in work practice it becomes at the same time productive and agentive: it gets involved in the re-configuration and co-constitution of this practice together with the actual users and designers. It is important to note that "the term 'practices' in this regard does not imply regularized patterns of human activity but rather the dynamic, situated and spatially and temporally extended alignments of people and things that go to make up activity of concern" (Healy, 2005, p. 244). The IT instantiation and implementation is not a mechanical process of data transfer from an old to the new system. Instead it involves a contentious and uncertain process of interpretation, adaptation, reconfiguration and redesign of (parts of) IT artefact as well as work processes, users' roles and tasks.

This discussion suggests that we can define *IS as apparatuses, that is, configurations of users, IT artefact, designers, work practices and other actors (e.g. different technologies), entangled in dynamic, iterative intra-acting* (illustrated in Figure 1). This intra-acting is complex and emergent as actors entangle and mutually co-create themselves. Data are captured through: updates (new entities), automatic recording processes (e.g. from customer transactions) and users' completions of tasks through an IT artefact (financial planning, purchases). Processed data (using various models and calculations) generate potential information for users. Moreover, by intra-acting with an IT artefact as part of completing work users make sense of and interpret available information, create views and understanding of their processes and performances and take actions. They also re-interpret, re-configure or change (together with developers) the IT artefact as part of their dynamic work environment. Through this intra-acting, users, work practices, developers and IT artefact are continuously reconstructing themselves (e.g. users' roles, work practices and the way they are performed; the meaning of an information from the IT artefact).

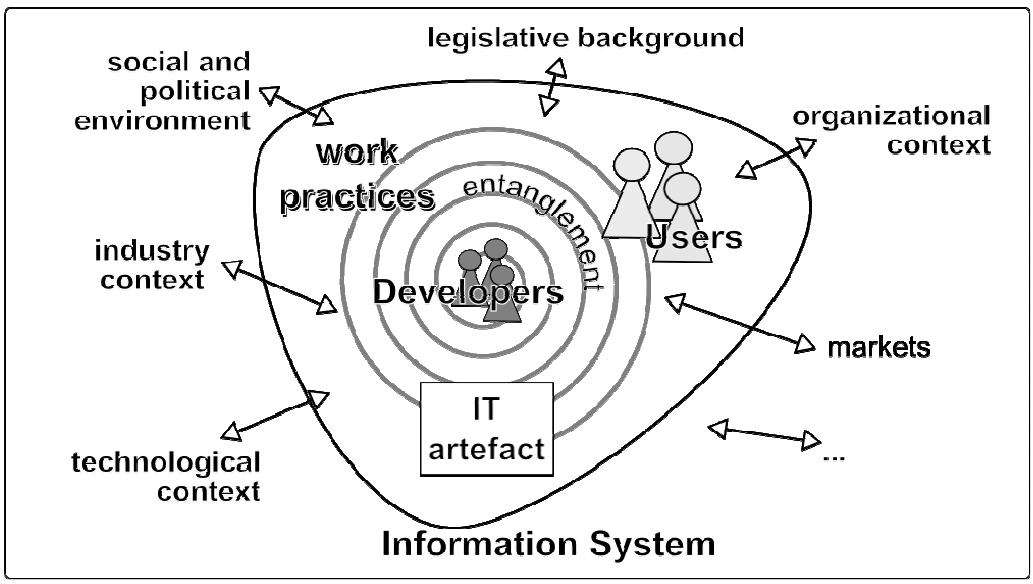

Figure 1. An IS is a sociotechnical assemblage of work practices, users, developers and IT artefacts entangled within the broader organizational, social, industry and other contexts.

While we define IS as an apparatus consisting of work practices (involving tasks, structures, norms and rules, materials etc.), users, developers, and IT artefact in intra-action we do not consider these components as separable during regular work processes (they are only analytically separate in Figure 1. However when, for instance, there is a new user the components of the assemblage become visible

as s/he needs to learn about them and become entangled with them. When the IT artefact breaks down it suddenly becomes visible together with its sociotechnical assemblages that made it operate (IT support, supplies). Similarly when work practices need to change due to broader changes in the environment (e.g. legislation) the inability of the IT artefact to deal with it becomes obvious, leading to its modification. Moreover, work practices, users, developers and IT artefacts can be part of different IS. For instance, users may be using different IT artefacts for different work processes, or one IT artefact can be used by different users, etc. While the same artefact will create the same potential information, in the context of different IS it may become different actual information. For instance, when the output of a transaction IS is fed into an DSS used by a different group of users. We can conclude that inherent to the notion of IS as an apparatus is continuous change as part of both agential intra-acting within and the changes in organizational and social context (the latter has been persuasively argued by Truex et al. 1999).

5 Implications for theory and practice

We have argued that IS are not devices representing reality, but instead that they can be understood as apparatuses in Barad's sense that both re-present and enact reality. While the input-processing-output model can provide a rough guide to the role of IT artefacts, it was argued that IS have to be perceived in a wider context that includes in addition to IT artefacts, users, developers, and the work practices they are engaged in. Importantly, participating components in this assemblage that we call IS are not seen as ontologically separate but are not always equally intimately entangled. This understanding has important implications for theory and practice as different conceptualizations of IS will influence how their role in organizations is perceived in their development, and use. A number of implications are introduced to exemplify this.

Potential information

Commonly IS are described as devices that process data as input into some output that is then labelled information (see discussion above). However, understanding IS as apparatuses questions this assumption. According to this understanding IT artefacts, the devices used for the processing of data, are only one part of an IS. In this sense the output of an artefact can only be seen as potential information to users (Boell & Cecez-Kecmanovic, 2011). Actual information are only those outputs that become meaningful and translated to specific users involved in specific work practices. This distinction is important, as no amount of processing can ensure that the output of this processing is actually meaningful and useful. Thus understanding IS as apparatuses highlights the difference between potential information that is produced by an IT artefact and actual information that is enacted through interpretation and use in the context of work practices. To understand how potential information is enacted and translated into actual information is highly important for designing IS and planning IS implementation and yet is not addressed by IS research.

Performing reality

In contrast to conceptualizations that see IS as representing *the* reality, the conception introduced here stresses that IS are not mere passive devices that represent reality (existing independently out there) but that they are intrinsically interwoven in performing *a* reality (Hovorka & Germonprez, 2011). Different devices, that is, different actors, IT artefacts or work practices, enact a certain view on the world while excluding others. Take for instance the case of Internet search engines. The way search engines crawl, filter, and rank websites in their results has an important influence on how the reality on the Internet is created: "algorithms such as Google's PageRank don't so much 'search reality' as create it," (Orlikowski, 2007, p. 1440). Understanding IS as devices that perform a certain reality allows new ways for theorizing the role and implications of IS in organizations. From this follows a shift from concerns with how to accurately represent reality in an IT artefact to more substantive concerns about the kind of reality organizations would like to enact through an IS, and responsibilities for its future enactment.

IT artefact, practices, developers and users

Understanding an IS as an assemblage of IT artefact, practices, developers and users posits explanatory power why and how the relevance of an IS will change over time. For instance, technology, legislation, or changes in an organization will affect how and what kinds of work processes are undertaken. This in turn can lead to an increasing mismatch among the different components of an IS. This rationale not only applies to work processes, but also to the IT artefacts and the users. Changes in any of the components can undermine an IS' ability to produce meaningful 'actual information' and act in practice. As an example of such a change we can observe how the perception of privacy and what is perceived as 'private' changes with more extensive use of social media. This triggered new design features and rules governing use. Another example is the shift of US security organizations to increased information sharing in the aftermath of September 11. As a consequence of this sharing a much wider range of users were granted access to classified content, resulting in reconfigurations of IT artefacts, work practices and users, that lead to less control over leaking of classified content into the public.

Development of systems

IT artefacts only allow the production of potential information which in itself will not produce benefits to an organization. This encourages a shift from the development of IT artefacts to the meaning making practices in which these artefacts allow the creation of meaningful information. IS development is not merely the process of creating information processing devices, but includes looking at work practices, users, and artefacts (Checkland, 2000). This includes for instance organizational interpretive schemes and meaning-making, politics and power (Cecez-Kecmanovic, 2002; Introna, 1997). The conception of IS as apparatus introduced here highlights the importance of understanding how components intra-act in training new IS professionals.

IS use and continuous adaptation

Understanding IS as apparatuses that represent and create realities points out the importance of IS to organizations and their abilities to perceive and react upon the changing environments (legislative, economic, technological, competitive …). This conceptualization reinforces the needs for more agile developments and continuous adaptation of IT artefacts. This is especially the case for types of IS where perception of and reaction upon the environment plays an important role for organizations, such as in Enterprise systems or DSS. The perception of what constitutes 'reality' will differ substantially depending on users and their practices. IT artefacts as part of IS should, therefore, not be seen as fixed but as continually adapting devices that evolve with users, work practices and organization (Truex et al., 1999). The ability to quickly adapt practice to a changing environment will require different means to foreground, filter, accumulate, and process potential information. User involvement is thus not only necessary to avoid failure, but more importantly may be vital for organizations. Organizations that can create devices that allow to foreground and filter data from the environment more flexibly can create competitive advantage by providing means that enhance the ability of creating potential information that are more likely to become actual information for their users.

6 Conclusions

This paper heeded Lee's call for defining and advancing the notion of information systems in order to advance the IS discipline and distinguish it from other disciplines:

> "It has been said that there is research that IS researchers do and IS journals publish, but which non-IS researchers can also do and non-IS journals can also publish. The prospects for the IS discipline are not good if it offers no added value or nothing distinctive in what it does compared to other disciplines. Actually using systems concepts, among other things, could play a major part in contributing to distinguishing the IS discipline and thereby justify its existence. Ultimately, the

IS discipline needs to employ systems concepts to a greater extent than it already has." (Lee 2010, p. 345)

This paper aimed to contribute to this call for debate. It argued that the dominating perspective on IS is taking a representational approach, according to which IS represent reality. In contrast to this it introduced an understanding of the IS concept from a performative perspective. By defining IS as an apparatus – an integrative phenomenon that both represents and enacts reality – we open a conceptual space for redefining the IS discipline in new ways. While the IT artefact is an integral ingredient in the IS phenomenon it is not more or less 'core' compared to users and work practices; we claim instead that *the entanglement of these components – the IT artefact, users, developers and work practices – is the core concept of the IS discipline*. And not only that, the entangled components, the IS apparatus does not exist outside of other assemblages in the organizational, social, technological, regulative and other contexts. As a result the IS discipline is uniquely positioned to study the IS phenomena embedded in the contexts and how they take part in transforming the ways we organize ourselves and live our lives.

Acknowlegements

We like to thank the reviewers, the associate editor and track chairs for their helpful comments, as well as the Australian Postgraduate Award (APA) for its financial support.

References

Barad, K. (2003). Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter. *Signs: Journal of Women in Culture and Society*, 28 (3), 801-831.

Barad, K. (2007). *Meeting the universe halfway. Quantum physics and the entanglement of matter and meaning*, Durham: Duke University Press.

Benbasat, I. and Zmud, R.W. (2003) "The Identity Crisis within the IS Discipline: Defining and Communicating the Discipline's Core Properties", *MIS Quarterly*, 29(2), 183-194.

Brown, J.S. and Duguid, P. (2000) *The Social Life of Information*, Harvard Business School Press.

Bocij, P., Greasley, A. and Hickie, S. (2008). *Business Information Systems: Technology, Development and Management* 4th ed., Harlow, England: Prentice Hall

Boell, S. and Cecez-Kecmanovic, D. (2011). Theorizing Information – From Signs to Sociomaterial Practices. In *ACIS 2011 Proceedings,* Paper 53.

Borgmann, A. (1999). *Holding on to reality: the nature of information at the turn of the millennium*, Chicago: University of Chicago Press.

Cecez-Kecmanovic, D. (2002). The Discipline of Information Systems—issues and challenges. In *AMCIS 2002 Proceedings*, 1696-1703.

Cecez-Kecmanovic, D. (2003). ISD Discourses and the Emancipation of Meaning. *International Conference on Information Systems Development*. Melbourne, 25-27.

Checkland, P. (2000). Soft systems methodology: A thirty year retrospective. *Systems Research and Behavioral Science*, 17(SUPPL.), S11-S58.

Checkland, P., and Holwell, S. (1998). *Information, Systems and Information Systems. Making sense of the field*. Chichester: Wiley.

DeSanctis, G. (2003) "The Social Life of Information Systems Research. Response to Benbasat and Zmud's Call for Return to the IT Artifact", *Journal of the AIS*, 4(7), 360-376.

Floridi, L. (2004). Information. In L. Floridi, ed. *The Blackwell guide to the philosophy of computing and information*. Oxford: Blackwell, pp. 40-61.

Haag, S. and Cummings, M. (2008). *Management Information Systems: For the Information Age* 7th ed., Boston: McGraw-Hill.

Healy, S. (2005). Toward a vocabulary for speaking of the engagement of things into discourse.

Journal of Environmental Policy and Planning, 7(3), 239-256.

Hovorka, D.S. and Germonprez, M. (2011). Towards an Informativity Account of Design Research. *Sprouts: Working Papers on Information Systems*, 11(2011), Paper 137.

Introna, L.D. (1997). *Management, information and power: a narrative of the involved manager*, Houndmills, Basingstoke, Hampshire: Macmillan.

Hassan, N. (2011) "Is Information Systems a Discipline? Foucauldian and Toulminian Insights", *European Journal of Information Systems*, 1-21.

Jessup, L.M. and Valacich, J.S. (2008). *Information Systems Today: Managing in the Digital World* 3rd ed., Upper Saddle River: Prentice Hall.

Latour, B. (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford, New York: Oxford University Press.

Laudon, K.C. and Laudon, J.P. (2010). *Management Information Systems: Managing the Digital Firm* 11th ed., London: Pearson.

Lee, A.S. (2001). Editorial. *MIS Quarterly*, 25(1), p.iii-vii.

Lee, A.S. (2004). Thinking about Social Theory and Philosophy for Information Systems. In *Social Theory and Philosophy for Information Systems*. Chichester: Wiley, pp. 1-26.

Lee, A.S. (2010). Retrospect and prospect: Information systems research in the last and next 25 years. *Journal of Information Technology*, 25(4), 336-348.

Lyytinen, K. and King J.L. (2004) "Nothing in the Center? Academic Legitimcay in the Information Systems Field", *Journal of the AIS*, 5(6), 220-246

McKinney Jr, E.H. and Yoos Il, C.J. (2010). Information about information: A taxonomy of views. *MIS Quarterly*, 34(2), 329-344.

Mingers, J. (2004). Real-izing information systems: critical realism as an underpinning philosophy for information systems. *Information and Organization*, 14(2), 87-103.

Moisiadis, F. et al. (2008). *Principles of Information Systems* 1st (7th) ed., Melbourne: Cenega Learing EMEA.

Musgrave, A. (1985). Realism versus constructive empiricism. Taken from: Churchland, Paul M. and Hooker, Clifford A. (Eds). Images of science. Chicago: University of Chicago Press. In M. Curd and J. A. Cover, eds. *Philosophy of Science: The central issues (1989)*. New York: W. W. Northon & Company, pp. 1088-1113.

OBrien, J.A. and Marakas, G.M. (2009). *Management Information Systems* 9th ed., Boston: McGraw-Hill.

Orlikowski, W.J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies*, 28(9), 1435-1448.

Orlikowski, W.J. (2010). The Sociomateriality of Organisational Life: Considering Technology in Management Research. *Cambridge Journal of Economics*, 34(1), pp.125-141.

Rouse, J. (1996). *Engaging Science: How to Understand its Practices Philosophically*, Ithaca: Cornell University Press.

Truex, D.P., Baskerville, R.L. and Klein, H. (1999). Growing systems in emergent organizations. *Communications of the ACM*, 42 (8), 117-123.

Van Fraassen, B.C. (1980). Arguments concerning scientific realism. Taken from: Van Fraassen, Bas C. The scientific image. Oxford: Clarendon Press. In M. Curd and J. A. Cover, eds. *Philosophy of Science: The central issues (1989)*. New York: W. W. Northon & Company, pp. 1064-1087.

Wand, Y. and Weber, R. (1990). Toward a theory of the deep structure of information systems. In J. I. De Gross, M. Alavi, and H. Oppelland, eds. *ICIS 1990 Proceedings*. Copenhagen: ACM Press, pp. 61-71.

Wand, Y. and Weber, R. (1995). On the deep structure of information systems. *Information Systems Journal*, 5(3), 203-223.

Worrall, J. (1989). "Structural realism: The best of both worlds?" *Dialectica*, 43(1-2), pp.99-124.