Theorizing Information – From Signs to Sociomaterial Practices

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Abstract

This paper seeks to contribute to better understanding of information within the information systems (IS) discipline. It argues that a hierarchical view on data-information-knowledge-wisdom – dominant in the IS discipline – is limited and that numerous other attempts to conceptualize information are worthy of exploration. The paper thus reviews literature on conceptualizing and theorizing information within and beyond the IS literature and proposes further theoretical development. Five different views on information are identified: material, engineering, objectivist, subjectivist, and inter-subjective. Underlying assumptions, examples and a critical discussion of each viewpoint are provided. The paper then proposes a sociomaterial and performative account of information according to which, information is seen to create reality rather than simply represent it.

Keywords

Information; Semiotics; Performative view of information; Sociomaterial view of information;

INTRODUCTION

One of the best indicators that a field of study has achieved a disciplinary status - Toulmin argued some 40 years ago - is a shared understanding and "enthronement of an agreed set of fundamental concepts" (1972, p. 381).. At the core of established disciplines are typically central concepts which drive their intellectual endeavour and which provide a common ground for their diverse branches and sub-fields. For instance, Chemistry, a well-established discipline, has a set of core concepts about the make-up of substances that are of common interest and shared among diverse and compartmentalized research domains focused on different problems, examined with different methods, and published in different journals. Similarly Information System (IS) research has been compartmentalized into different branches and sub-fields, pursuing different problems, and adopting different methods (Banville and Landry 1989). However, IS researchers have shown little interest in exploring fundamental concepts such as data, information or information system across the diverse branches of the IS discipline.

IS researchers are, therefore, called upon to engage with central IS concepts, such as 'information' and 'information system', in order to advance the intellectual core of IS and thereby advance IS research and practice. More than a decade ago Checkland and Holwell (1998) argued that reflecting on the concepts of 'information' and 'organization' can help to further IS research and practice. And recently Lee (2010) reminded the IS community of the importance and the necessity to define and theorize the constructs of 'information', 'system', 'theory', 'organization', and 'relevance'. This was backed by Baskerville (2010) and Davison (2010). A call echoed by Mckinney Jr and Yoos Il (2010) who argue that while 'information' is central to a discipline called Information Systems there is no clear conceptualization of the term in much of the IS research: "IS research takes the term information for granted and, importantly, fails to identify its underlying assumptions about information, and therefore condition its research results" (p. 330). Conceptualizations of information in IS are predominantly simplistic. When employed in IS research information is seldom explicitly defined, with a majority of publications being based on an implicit understanding in which information is more or less equivalent to data (McKinney Jr and Yoos Il 2010).

In addition to how information is implicitly applied in research it is relevant to look at how the concept is explicitly conceptualized. As Checkland and Holwell (1998) state broad understanding of concepts within the IS field are reflected in introductory literature. A survey of textbooks by Rowley (2007) identified an hierarchical data–information–knowledge–wisdom understanding of information as preponderant. A conceptualization critiqued, for instance by Kettinger and Li (2010) as failing to acknowledge the interplay of knowledge and data or for general assumptions behind an hierarchical assemblage (Fricke 2009). To further the concept of information for IS it is therefore relevant to look beyond the current understanding:

"information is a pivotal IS term. The lack of attention by the IS field to the various views of information has restricted theory development as researchers neglect to specify assumptions that underlie the concept and treat information as a general purpose solution to an increasing range of problems," (McKinney Jr and Yoos Il 2010:342).

In order to further the concept of information in the IS discipline it is necessary to engage with the broad range of current theories and conceptualizations of information. This in itself is a challenging task as there are thousands of papers in different disciplines engaging with the concept at a theoretical level (Wersig 1997). Relevant literature on information are not only found in IS (e.g. Boell and Cecez-Kecmanovic 2010a; Introna 1997 ; McKinney Jr and Yoos Il 2010; Mingers 1996; Stamper 1991); but also in Information Science (e.g. Capurro and Hjorland 2003; Cornelius 2002)); Communication (e.g. Rice et al. 2001); Philosophy (e.g.Fetzer 2004; Floridi 2009; 2004) and even Physics (e.g. Stonier 1990). Engaging with a broader range of this literature is necessary if one wants to grasp the extraordinary complexity of the term.

This paper seeks to advance understanding of information specifically within IS. The paper is conceptual in nature. It builds a theoretical argument for a novel, sociomaterial concept of information. It does so by (1) providing a extensive overview on information in a wide range of literatures, showing the richness of conceptualizations of information beyond the 'data, information, knowledge, wisdom' hierarchy. Based on this literature the paper (2) classifies different views on information into five broad categories and critically assesses their characteristics and implications. And finally building on this foundation (3) the paper argues for a performative, sociomaterial understanding of information that is situated in sociomaterial practices from which it emerges and within which it acts and makes a difference.

METHODOLOGY

In order to develop further a conceptual approach to information for IS we conducted an extensive literature review on the topic. To tackle information in the context of IS we need to engage with a wide range of literatures in order to appreciate and address the extraordinary complexity of the concept. In this paper we provide an overview and critically revisit different views and conceptual framings of information. Based on such a critical review we propose a more nuanced and comprehensive account of information that addresses some of the identified issues in conceptualizing information in the literature and also advances the intellectual core of the IS discipline.

Because of the complexity of the topic and the aim of the research we adopted a hermeneutic approach for conducting the literature review (Boell and Cecez-Kecmanovic 2010b). Following this approach the literature review was initiated by first engaging with overview literature on information such as earlier literature reviews and entries in subject specific encyclopaedias. These literatures ensured a fair understanding of information from different perspectives stretching from IS (Mingers 1996); to Information Science (Capurro and Hjorland 2003; Cornelius 2002); Communication (Rice et al. 2001); the natural sciences (Fischer 1993); philosophy (Floridi 2009); and psychology (Collins 2007). It also allowed us to develop an appreciation of the complexity of different notions of information and critically asses them in terms of their potential relevance and usefulness for IS. Engaging with review articles lead to follow up further relevant literature and drilling deeper using database searches. These searches and the hermeneutic investigation of identified literature allowed us to critically engage with numerous conceptualizations of information including for instance the hierarchical view (e.g. Ackoff 1989; Bellinger et al. 2004; Tuomi 1999), so called 'information theory' – based conceptualizations (Shannon and Weaver 1949; Shannon 1948) and others.

This paper is based on a selection of literature on information that is of relevance to IS but is not limited to IS sources. In total more than a hundred articles and books engaging with information were selected and read in depth for this review. The sources selected allowed us to gain understanding of the emergence of key ideas and viewpoints and to classify different conceptions present in the literature. By critically engaging with them, we open several promising directions for understanding and exploring information in the IS discipline. In particular we draw from a sociomaterial philosophical approach to offer a new and potentially rich conceptualization of information and discuss its contribution to the IS discipline.

CONCEPTUALIZATIONS OF INFORMATION

Identified literature on information was classified according to different viewpoints emerging from different streams of literature. In total five different views have been identified (see Table 1) that belong to two major streams, a 'physical stream' and a 'semiotic stream'. The first stream consists of literature that conceptualizes information as part of the physical world, existing independently of human beings. Key exemplars are Shannon's (1948) "information theory" and Bates' (2005) concept of information as a "pattern of organization of matter and energy". The second stream of literature can be broadly associated with semiotics in the sense that information is related to signs and human meaning making. The key examples are Mingers' (1995) view on information and meaning and Kettinger and Li's (2010) theory of "knowledge-based information".

Both streams can be further subdivided. The physical stream has a 'materialist view' exemplified by Bates' (2005) definition of information and an 'engineering view' that seeks "to establish a measure of information in terms of purely physical quantities" (Hartley 1928:536) which often relates information to entropy.

Table 1. Overview of approaches to information

View		Definition	Assumptions about information	Key Proponents
Physical	**Material-ist view**	"Information is the pattern of organization of matter and energy." (Bates 2005)	- exists independently of humans; - often related to thermodynamic entropy;	Bates 2005; 2006; Stonier 1989; 1990;
	Engine-ering view	Concerned with communication of messages between a sender and a receiver; information is a message selected from a set of possible messages (Shannon and Weaver 1949) "a measure of information [is established] in terms of purely physical quantities" (Hartley 1928:536)	- exists independently of humans; - semantic aspects are irrelevant; - is measurable; - is context free; - is linear and diadic;	Hartley 1928; Shannon 1948; Shannon and Weaver 1949;
Semiotic	**Objectiv-ist view**	"Signs carry objective information, but humans cannot access this" (Mingers 1995,:303) "Information is an objective, although abstract, feature of the world in the same way as are physical objects and their properties" (Mingers 1995:295) Information is processed data; data are raw 'facts' that describe entities and their properties; they simply exist as recordings or traces of reality (Bellinger et al. 2004)	- exists independently of humans; - is embedded in signs; - is divorced from meaning; - is carried by signs and can be interpreted differently by individuals;	Dretske 1981; Mingers 1995;
	Subjec-tivist view	"Information is an inward-forming. It is the change in a person from an encounter with data. It is a change in the knowledge, beliefs, values or behavior of the person." (Boland 1987:363) "Information is the meaning produced from data based on a knowledge framework that is associated with the selection of the state of conditional readiness for goal-directed activities." (Kettinger and Li 2010: 415)	- is dependent on individual; - often related to cognition, knowledge and values of individuals; - "caused" by stimuli; - does not acknowledge context;	Boland 1987; Belkin 1980; Kettinger and Li 2010;
	Inter-subjec-tive view	"information is inherently bound closely with numerous phenomena – language, action, logic and technology" (Beynon-Davies 2009:5) "information ... is a process of creating, adjusting and maintaining relationships among the participants in a drama or real task." (Stamper 1991:522)	- is dependent on individual as part of a community; - is different for different groups; - is contextual; - is situational; - is part of a dynamic process;	Beynon-Davies 2009; Goguen 1997; Romm 1997; Stamper 1991;

In contrast, the three semiotic views see information as related to signs and human use of signs. However, in each of these information is residing at different places resulting from different processes. According to the 'objectivist view' information is factual, meaning that "signs carry objective information, but humans cannot access this" (Mingers 1995:303). This view sees information as objective facts about the world and as a consequence of this information cannot be false (Dretske 1981). In contrast the 'subjectivist view' points out that the same message will be information to some while being irrelevant to others. Information is therefore seen as something that occurs within an individual: "Information is an inward-forming. It is the change in a person from an encounter with data. It is a change in the knowledge, beliefs, values or behavior of the person" (Boland 1987:363). And finally the 'inter-subjective view' acknowledges the individual character of information but points out that meaning and relevance are not arbitrarily individual but that they rely on shared sociocultural understanding and norms: "Information is inherently bound closely with numerous phenomena – language, action, logic and technology" (Beynon-Davies 2009:5). In order to provide a comprehensive review we briefly discuss each view but allow more space to semiotic views which – we argue – are more relevant to the IS discipline.

Materialist view on information

One branch of physical conceptions of information link information to organization in the physical world (Stonier 1990). For instance, Bates (2005) describes information as "the pattern of organization of matter and energy"; Houston and Harmon (2002) argue that data consists of three of the basic dimensions of the universe: mass, distance, and electrical charge, and that information is the summation of those basic units over time. However, most commonly used materialist views of information are based on the concept of thermodynamic entropy (Stonier 1990). A view summed up by (Bates 2006) as "the only thing in the universe that does not contain information is total entropy" (p. 1033). In the context of thermodynamics information is often understood as opposite to entropy (Brillouin 1951).

While this stream of literature on information is immense, its relevance for IS is limited. There are some connections between this type of conceptualization and IS in the context of cybernetics. However, definitions of information such as Wiener's (1961) "Information is information, not matter or energy" (p. 132) or "the amount of information in a system is a measure of its degree of organization" (p. 11) have not seemed to advance understanding of information within IS.

Engineering view on information

The engineering view on information also sees information as related to the physical world, however, the main concern of this view is uncertainty in regards to signal transmission. The most prominent contribution to the engineering view is Shannon's work (1948) which, building on Hartley (1928), aims "to establish a measure of information in terms of purely physical quantities" (p. 536). Shannon developed a mathematical theory that allowed measuring the "amount of information" that can be transferred over a particular channel with a specified degree of reliability. In this context the smallest amount of information that can be transferred is known as 'bit', the distinction between two separate states. In essence Shannon's theory allows us to calculate a required channel capacity for the transmission of signals given a desired degree of noise resistance.

While Shannon's theory has arguably been influential, it has not been without critics. Often raised are concerns regarding the naming of the theory as 'information theory' implies a general approach towards information. However, this is not the case as Shannon and Weaver (1949) argued themselves: "The word information, in this theory, is used in a special sense that must not be confused with its ordinary usage" (p. 88). Some have argued that Shannon's theory would be more appropriately labelled a 'theory of signal transmission' (Capurro and Hjorland 2003). In addition Shannon's theory is not concerned with semantic and pragmatic aspects of information, which are of particular importance to IS (Mingers 1996). (For further critical discussion of Shannon's work see for example Beynon-Davies, 2009 and Floridi, 2009).

In the context of business the desire to quantify information may be partially driven by the need to assess the value of information. According to such an understanding information is seen as commodity (Meadow and Yuan 1997). However, while information certainly may have value, different types of values can be distinguished, in the context of information most importantly 'use value' and 'exchange value' (Taylor 1986). Directly linking both types of values is however not possible as use value can only be assessed after information was received. "The value of information is not fixed as it is for most commodities; it is contextually determined. Its full value is not known until it is used" (Rice et al. 2001:37). Applying a commodity view onto information thus does not allow understanding "the essence of the nature of information" (Meadow and Yuan,1997:706).

Objectivist view on information

According to an objectivist understanding – out of the semiotic understandings – information is defined as a true fact about the world that exists independently of humans. In this sense the objectivist understanding of information is closest to physical understanding. "Information is an objective, although abstract, feature of the world in the same way as are physical objects and their properties," (Mingers 1995:295). As a consequence of this understanding information has to be true (Dretske 1981; Floridi 2009). As rightly critiqued by Fetzer (2004) there is no place for misinformation, disinformation or false information.

Objective conceptualizations of information provide therefore a sense of legitimacy to information that promote information to 'objective facts' as opposed to 'subjective statements' (Romm 1997). Portraying information as objective thus allows us to obtain authority in discourse:

> "The deployment of information is often used as a method to persuade someone or some group. Information becomes a basis upon which conflicts are resolved. In such cases, information is interpreted and reconstructed to serve the purpose of each party. The legitimacy granted to, so regarded, objective facts provides a resource that the parties can draw on to capture the moral higher ground to justify their actions or decisions," (Introna 1997:42).

Moreover, objective conceptualizations of information are often linked to the physical world as physicality can provide a tangible rational for such an understanding. For instance Adams (2004) argues that "To be of value to a would-be knower, information must be an objective, mind-independent commodity." (Adams 2004:229).

However, this begs the question if there is such a thing as "raw" information or "raw" data in the first place (c.f. Cole 2008). Any assemblage created to capture this "raw" information is inevitably based on certain sensors measuring certain properties while excluding others. However, the construction of such sensors, measuring instruments and IS is based on certain understanding which elevates some properties to the status of data or information while denying it to others. "Raw" information or data is therefore not raw but already loaded with meaning (and also interests) which are ascribed to certain properties of the universe.

Subjectivist view on information

Approaches that emphasize a subjectivist view argue that information is different for every recipient. In this context authors emphasize the 'inward-forming' of information: "Information is an inward-forming. It is the change in a person from an encounter with data. It is a change in the knowledge, beliefs, values of behavior of the person," (Boland 1987). Similarly Brookes (1980) describes information as that which changes the knowledge structure of an individual K(S) which he succinctly expressed in his formulation as: $K(S)+\triangle I=K(S+\triangle S)$. This view was criticized by Cornelius (2002) as lacking acknowledgement of the importance of context and that does not indicate how the change from information to knowledge takes place. Others emphasize the relationship between knowledge and information, in the sense that information alters the knowledge of an individual in a way that enables the individual to take action. Kettinger and Li (2010) argue that individuals apply particular knowledge to data when they obtain knowledge: "Information is the meaning produced from data based on a knowledge framework that is associated with the selection of the state of conditional readiness for goal-directed activities," (Kettinger and Li 2010: 415).

The subjectivist view on information highlights that interaction with IS is an individual and personal experience that may differ from user to user. It emphasizes that individuals have to make sense of information produced by IS and that successful design of IS has to take into account cognitive processes of users. One strength of the cognitive perspective is that it can explain why something that is already known by a receiver is unlikely to be information as it lacks the ability to change the cognitive structure of an individual (Meadow and Yuan 1997). Another strength is that it can explain why information is different for different individuals. Something an individual cannot connect to prior knowledge will not be information as an individual lacks the ability to make appropriate connection necessary for integration of information into their cognitive structure.

Inter-subjective view on information

The inter-subjective view sees information as context dependent and situational. While an individual's experience of information is unique, information is bound to social practice. After all the cognitive dimension of information is affected by the knowledge structure of an individual and understanding of a social context. In other words information is socially (re)constructed (Romm 1997). There are numerous examples of the inter-subjective and sociocultural dimension of information. Beynon-Davies (2009) for instance explains how the development of artefacts and written language shape the way how people memorize, structure or solve problems, and store information.

An inter-subjective view can thus reveal why similar information is interpreted differently by different social groups and organizations. Arguably the most advanced attempt to conceptualize information within a wider semiotic context that includes the social world as well as the physical world can be found in Stamper's work (1991). Stamper extended the semiotic dimensions of syntax, semantics and pragmatics in order to include the different physical carriers that are used for the transmission of information. He argued that when looking at syntax we are already assuming that different characters can be distinguished. However, Shannon's work (1948) showed that the distinction between different characters cannot be taken for granted. Stamper introduced therefore 'empirics' as additional dimension in his semiological framework. In addition Stamper (1991) emphasized that empirics does not include the complete set of the physical world as only certain properties are used for the transmission of signals. This becomes evident when we look at how means of transmission and storage of information in IS have changed over time (Wright 2007). Take the example provided by Taylor (1986) who points out that transmission of information over space requires light and easy media, whereas transmission over time requires durable and heavy media. Similarly the ease of manipulation of information may be bound to its physicality.

Stamper's (1991) semiological framework for information is the most elaborate theoretical model, widely recognized in the IS discipline (see e.g. Beynon-Davies 2009 who adapted it). This framework however implies ontological separation between the different dimensions of information, from empirics, to pragmatics. Any information, we argue, exists simultaneously at all layers of Stamper's semiological framework. Defining information at different layers is therefore an artificial separation of something that is in its existence inseparable.

INFORMATION AS PERFORMATIVE AND SOCIOMATERIAL

Information is at the same time physical (e.g. recorded and communicated via electronic media), cognitive and individual-specific due to different abilities to comprehend and interpret signs or texts, while also being socially

and culturally shaped. Information is therefore neither fully determined by nor independent of a particular context (Goguen 1997).

Information links the subjective with the objective, the material with the sociocultural in the sense that "information is a difference which makes a difference," (Bateson 1972). Information is therefore shaping reality as "there is a deep sense in which we can understand [...] patterns of difference that make a difference - to be the fundamental constituents that make up the world," (Barad 2007). So in this sense we are conceptualizing information as part of sociomaterial practices that are making and remaking the world. This leads us to explore a sociomaterial nature and performative understanding of information.

Representational vs performative view on information

A key aspect in defining information is its relation to reality. Does information represent reality as most of the views on information assume? The concept of information as objective or subjective and also as processed data assume an epistemology of representationalism (Barad 2007; Rouse 1996). The objectivist notion of information carried by signs assumes it is a true and objective representation of an event or a state of affairs. The subjective view on information according to which an individual perceives and interprets signs depending on his/her cognitive abilities and prior knowledge, assumes a subjective representation of reality.

This is also the case with the data processing view on information. When data are collected (recorded) and processed in order to produce information it is assumed that they represent an 'objective' reality (entities and their relations either of the material or the social world) and that such representations and reality they (intend to) represent exist independently of one another. Representationalism, Barad explains, "is the belief in the ontological distinction between representations and that which they purport to represent; [and] in particular, *that which is represented is held to be independent of all practices of representing*." (2007:46; our emphasis). Such a view of information and consequently IS inevitably raises the question of 'accuracy' and 'completeness' of reality representations (e.g. representation of business processes in IS) which has been extensively studied in IS research.

Due to representational thinking in defining data and information in IS, the illusion that IS 'map' business processes (the reality) is maintained. What remain hidden are the processes and practices of converting certain views of reality into 'objective descriptions' and hence 'facts', which are then used to process information. The problem is that:

> "Representational thinking results from the erasure of the processes and practices enabling, generating and reproducing cognitive representations. This erasure legitimates representationalism because with it these representations then simply mirror the world. 'Facts' speak for themselves for precisely this reason. They are granted autonomy – status as 'things in themselves' – by denying the human effort and artifice involved in their manufacture," (Healy 2005).

Moreover, the assumed rigour of the business and information analysis legitimises an information system's matter-of-factness, which is seen as a guarantor of information objectivity and neutrality. Information as objective and interest-free representation of reality disregards the sociomaterial contexts in which is it produced and practices that produce and consume it. In any sociomaterial context, it will be hard to deny the workings of a variety of interests and power relations. Information does not happen in a vacuum and cannot be separated from social, material and political contexts, power and interests in an organization or society.

A starting point in defining information based on a non-representational epistemology is questioning the a priori ontological separation between the human/social/organisational and the material/technological. Instead of assuming information as objective and neutral representations of reality, of either the material or the social world, a non-representational epistemology is concerned with the production and legitimation of information 'in terms of participation in the world' (Healy 2005). Information is seen as part of material-discursive practices that do not describe but rather co-constitute reality and organizations.

This draws attention to situated material-discursive practices within which information is defined and IS analysed, designed, applied and used. Following Healy (2005) "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" (p. 244).

The critique of representational thinking suggests that the notion of information as providing objective and neutral representations of reality is hiding more than it is revealing. In Barad's words:

> "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 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," (Barad 2007:49; emphasis in the original).

Extending Barad's view we argue that information cannot be divorced from sociomaterial practices within which they are produced, used and acted upon, practices that change as a result. Information results from actors' direct material-discursive engagements with the world. Instead of a representational view, we therefore propose a performative view of information that takes into account the practices and performances of representing, that is, *apparatuses of representing*. Information can thus be defined as non-separable performative representations and apparatuses of representing as part of specific material-discursive engagements with the world. In other words, information as both apparatus and performative representation (re)produce phenomena they represent. Being performative, information involves reconfigurations of the material-discursive world.

A sociomaterial view on information

Performative understanding of information in relation to IS can be further developed by reinterpreting (Stamper 1991) semiological model and integrating all aspects into a sociomaterial character of information. Instead of assuming an ontological separation among different aspects of information in the Stamper's model, we argue that information is always related to all aspects at the same time. This allows us to gain a better understanding of the production and use of information as part of sociomaterial practices.

Differences in the world are expressed through signs (linguistic and non-linguistic). Through material-discursive engagements of humans, signs and other non-humans (e.g. technology), signs may become information, which when used and acted upon may produce effects in the world, and in turn new signs. Not every sign expresses a difference that makes a difference in a particular practice, hence not every sign becomes information. For signs to become information in a context of sociomaterial practices they need to be comprehensible (empiric dimension) and belong to a sign system and conform to its syntactic rules (e.g. language) known by actors in these practice (syntactic dimension). Furthermore, actors need to be able to interpret, make sense of and derive meanings from signs (semantic dimension); depending on a situation actors may share or engage in negotiating meanings. Finally, actors act and make use of information derived from signs and change the world (pragmatic dimension). This indicates that to become information signs have to be understood by and be relevant to actors in their material-discursive practices and organizing contexts. Interpretation and relevance change as actors engage in different practices, pursue different goals or strategies. The way information is continuously derived from signs through material-discursive engagements in practices suggests that all these dimensions are integratively present (Figure 1).
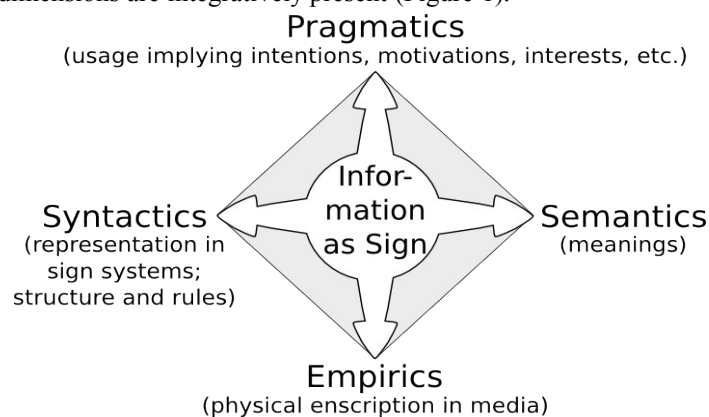

Figure 1 Sign as information.

Within this framework, information can then be understood as particular signs that are meaningful and relevant within a particular sociomaterial context, for instance, work and decision making processes, involving interests and goals. In order to fulfil such criteria signs not only have to be available, understandable, meaningful, and matching an actor's cognitive and perceptual abilities but they also have to be relevant for a specific purpose and objectives. Signs play a role in human experience and relations in the world. In addition to direct bodily-sensory experiences humans relate to and are present in the world through signs. Humans derive information from signs to learn about and relate to reality – processes, events, and situations they are engaged with, and thereby act and participate in the reality making.

Signs may be recordings of certain events (e.g. recordings of purchased items at the supermarket counter) or properties of things (e.g. an item price). Signs are thus related to events, objects, humans and non-humans as part of a sociomaterial context. Signs therefore signify intended information by actors engaged in the practices where signs are generated (Figure 2). When stored in IS, signs have a potential to become information for actors that are users of the system (potential information). However, it is important to note that IS can therefore only store signs but not actual information. Finally, in a particular use situation, intended information may become information-in-use if it is of relevance to a particular issue at hand (Figure 2). This process of generation of intended information and use of information can take place either within the same or between different sociomaterial practices as indicated by dotted shapes in Figure 2.

Subsequently the aim of IS is to allow actors to become informed and effectively act within a particular sociomaterial practice. That is, IS should facilitate information-in-use in the sense that they allow actors to derive information which is of relevance to them for a task at hand. Given that intended meanings of signs stored and manipulated in IS are located in the practices of analysis and design (during sign generation), it is not surprising that information emerging from the use of signs in different sociomaterial practices would not necessarily be the same. This is a non-trivial problem often underestimated in the development of IS, especially when systems are deployed using packaged software.
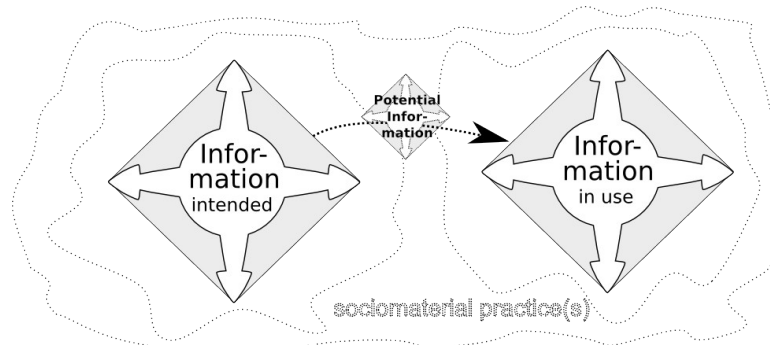

Figure 2 Signs as intended information, potential information and information-in-use.

Intended information and information-in-use can be part of the same, but also different sociomaterial practices. This indicates that potential information stored in IS may not necessarily become information-in-use. For example, our model posits an explanation why information shared between departments, different levels of management, or obtained from external sources, is less likely to constitute information-in-use than information shared within a sociomaterial practice. It also indicates that exchange of information is facilitated through different means (empiric, syntactic, semantic, and pragmatic) and that the better these means match between the generation of intended information and information-in-use the more likely it is that potential information stored in an IS may become used information.

Furthermore, information understood as being part of the same sociomaterial practice does invite discourse and allows us to conceptualize the changing nature of information and IS entangled with changing organizations. This indicates the need for continuing adaptation of IS. Practices change over time and consequently intended information at some point will drift further and further away from information-in-use. Thus an important aspect of IS is continuous adaptation of intended information stored as potential information in IS to the changing information needs of actors (Truex et al. 1999).

CONCLUSION

This article introduced an overview of the range of views on information showing that information is conceptualized differently at different places ranging from entirely physical understanding to semiotic understanding in which information is related to signs. Views that favour physical understanding often see information as material or measurable, while in contrast views that see information as related to human meaning making emphasize cognitive and social perspectives. Each view emphasizes different aspects of information, bringing different assumptions about information to the fore. Each has therefore different implications for theorizing information in IS. For instance, the material view, engineering view, and the objective view all see information as human independent. While this perspective potentially allows full automation and computation of information, it fails to acknowledge that information can be different for different individuals. Moreover, the subjective view emphasizes that what constitutes information for a particular individual will depend on cognitive processes. Someone who has not been trained in using a particular IS is unlikely to be able to derive useful information from such a system. Finally, an inter-subjective perspective on information highlights that signs might be signified differently in different practices and sociocultural contexts. Therefore, information associated with particular signs will differ as well. According to an inter-subjective understanding of information, IS are inherently interwoven with the sociocultural context in which they are used.

Based on our critical reading of existing conceptualizations of information in the literature we proposed a performative understanding of information embedded within and generated through sociomaterial practices. Using the conceptual distinctions we make in this paper we can say that IS analysis is concerned with the selection of signs that are comprehensible, meaningful and relevant in specific sociomaterial practices. Furthermore IS design is concerned with the development of apparatus that can process such signs. While signs are recorded, stored and processed in IS, information is something that emerges through the use of signs within sociomaterial practices. The use of signs involves comprehension, interpretation and action. Information that is derived from signs in a sociomaterial practice is performative: it creates reality for actors rather than simply representing it.

We posited that information are signs that have meaning and are relevant in a given sociomaterial context. In this sense, information is a difference that makes a difference. While signs are expressions of differences, not every difference makes a difference within a particular sociomaterial practice. Building on Stamper's work (1991) we argued that signs that become information involve simultaneously empiric, syntactic, semantic, and pragmatic dimensions. Importantly IS, therefore, have to convey signs that are comprehensible, meaningful, and relevant in a given sociomaterial practice. They have to be able to convey meaningful differences. If such differences are aligned with the practices of their users, they may result in information-in-use which will allow users to engage with reality in a meaningful and productive manner. This conceptualization of information is of particular interest to the IS discipline as it allows a holistic approach to information creation, storage (in IS), use and sharing entangled with organizational performance and change. Information and consequently IS are conceptualized as part of continuously emerging sociomaterial practices (Orlikowski and Scott 2008), which addresses a relationship some have argued is central to the IS discipline (Lee 2001).

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