Information, Systems, Hence, Information Systems: The Case for Ontological and Epistemological 'Depth'.

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Abstract

This paper presents a critique of the atomistic ontology and empiricist epistemology which inform most current definitions of the concepts information, systems and, hence, information systems in the Information Systems (IS) literature. The notion of information as an objectively given quantifiable 'force' emanating from the real world and endowed with the essential property of dissolving uncertainty; or as possessing the same essential property but as consisting of structured or processed data, i.e. atomistic 'facts', about the real world are argued to be unsustainable, on both philosophical and practical grounds. It is argued, furthermore, that the notion of systems as an ontology in respect of goal-seeking cybernetic machines unproblematically specifiable in terms of their boundaries, of their input and output, and of their objectives is not only inappropriate to the socially-based systems in terms of which an IS must be defined, but also fails to consider the ontological, and consequently epistemological, depth implied by this concept. In view of these arguments, an alternative conceptual practice is explored by suggesting that the concept system be taken as an epistemological tool to be deployed in respect of complex coherent 'whole-entities' characterised by their emergent properties and, in the case of socially-based systems, by the essential autopoietic nature of their modes of regulation and self-representation including, above all, language. It is also suggested that 'informaction' be considered as a set of, fundamentally, arbitrary signs whose 'emergent' properties, i.e. syntactic, semantic and pragmatic, are intersubjectively negotiated between intentional organisational agents and, as such, inseparable from the forms of social life which they sustain and in which they are generated. This alternative conceptualisation, proceeds from an ontology which acknowledges the essential 'depth' of its key thought objects, by virtue of the emergent properties attributable to these objects, in contrast to the 'flat' atomistic ontology currently dominant in the IS field. Such an alternative conceptual practice, we argue, provides an initial theoretical framework in which to ground the currently ill-defined, "emergent perspective" on the relationship between ICT and organisational change, identifiable in the IS literature. While as regard IS practice, this re-conceptualisation is found to be congruent with the object oriented approach to IS development which is currently attracting increasing practical attention and which appears to provide the basis for a common and intuitively meaningful language with which to bridge the gap between IS end-users and developers.

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Introduction

In this paper we set out to address the critical, though much neglected, task of conceptualising 'information' and 'systems' as two basic 'thought objects' in Information Systems (IS) theory. In social research, as Sayer (1992) has argued, "so much depends [...] on how we conceptualize key objects [...] All such starting points are fraught with problems which whether noticed or not, shape the course of research long before 'methods' in the narrow sense of techniques [...] are chosen". In spite of the evident importance of the concepts information and systems in IS theory and practice, however, a review of their respective definitions in the IS literature reveals a high degree of confusion as regard the nature of both these concepts. This conceptual confusion in IS as a relatively young field of academic research may be attributed to several contributing factors. In particular, as discussed below, a similar condition is encountered in those reference disciplines which provide IS theorising with some of its essential concepts, most notably Information and Systems theories. We would argue, furthermore, that such confusion is in fact nurtured by a prevalent attitude characteristic of IS as of much social science practice whereby "'never mind the concepts, look at the techniques!' might be the slogan" (Sayer 1992). More fundamentally, though, the origin of this confusion can be found to reside in some difficult, though unavoidable, underlying philosophical issues of significance to both IS theory and practice. "Data modelling [i.e.] perceiving, organising and describing data", as Klein and Hirschheim (1987) have argued, "shares important issues with the epistemological and ontological questions: how is valid knowledge acquired, and what is the nature of the world to which it refers?", including of course the nature of data/information and of systems. Essentially, the task of conceptualising data/information and systems involves an initial ontological and epistemological commitment with regards to what is taken as 'given' in our universe of discourse, and in its simplest expression the difference between the main contending positions has come to rest on whether the nature of that 'given' is believed to be "the contents of immediate experience" or, alternatively, "the forms of life which make experience possible" (Scruton 1984).

This issue is clearly significant in the context of IS development practice, in terms of alternative approaches to data-modelling. In respect to these, as Klein and Hirschheim (1987) have argued, two "antithetical paradigms" can be distinguished: the "objectivist", according to which "one believes that a data model 'reflects' reality" and the "subjectivist", according to which a data model is believed to consist "of subjective meanings and thereby constructs reality". This initial assumption about the nature of data/information is of further significance in connection to the 'causal structures' (Markus & Robey 1988) adopted in IS theories about the relationship between Information and Communication Technology (ICT) and organisational change. As Markus and Robey (1988) have argued "much [IS] research has adopted variance theory formulation of logical structure [which] posits an invariant relationship between cause and effect when the contingent conditions obtain, and an imperative conception of causal agency; [either] technological imperative [or] organisational imperative". Both imperative perspectives and the variance theory in terms of which they are cast can be shown to proceed on the basis of an atomistic ontology as regards the nature of data/information, and of an empiricist epistemology as regards data/information and systems. As such, however, these claims to knowledge can be said to be grounded in "a particular empiricist account of science that finds its origin in philosophical reflections upon Newtonian physics [...] which ignores the alternative conceptual possibilities suggested by other sciences and contemporary physics [and] which has been largely abandoned by contemporary philosophers of science".(Greenwood 1991).

In the light of the above argument, the purpose of this paper is to explore alternative conceptual possibilities as regards information, systems and hence information systems. In the next section, two dominant conceptual practices as regard the concept information and systems in the IS field are identified. We then develop a critique of these practices on the grounds of their commitment to the principles of atomism and of empiricism. Finally, we suggest an alternative conceptualisation of our key thought objects by considering information from the perspective of Semiotics and by considering the concept systems in terms of its modern form in Systems thinking.

Information and Systems: An empiricist account

Although evidently central to any theoretical discussion about IS it is remarkable how often the concepts information and/or systems remain undefined in the IS literature, including some influential research frameworks (Gorry & Scott Morton 1971; Ives et al., 1980; Huber 1982). This is all the more remarkable in view of the fact that the explicit definitions of these concepts found in the literature reveal not a broad consensus, which would explain why the nature of these concepts may be taken for granted, but on the contrary a great deal of confusion. As was suggested earlier, this confusion may be accounted for, partly at least, by the fact that a similar situation is also evident in the field of Information and that of Systems. Thus, an analysis of the concept information in the field of Information Science, as Williams & Clark (1992) have argued, "begins with a journey into the morass of defining what constitutes information [...] many attempts have been made to provide a definition of information that is generally accepted by all researchers. To date, [...] the literature is replete with divergent definitions of the term". While as regard the concept systems in the Systems field, Checkland (1992) has recently argued that "after 40 years of the systems movement we still get the fundamental systems ideas introduced in the systems texts in random lists [...] we are told neither the criteria for selecting these ideas nor the rationale behind the order in which they are presented.... we seem to be confused about even the most basic of our ideas". Although a review of the current definitions of these concepts in the IS literature does reveal a similar definitional morass with respect to information together with fairly random lists of ideas with respect to systems, a few key assumptions can nonetheless be said to constitute the dominant conceptual practice as regard the nature of information and systems in the IS field.

Information

Two dominant types of conceptual practice can be identified in the IS literature with respect to the concept information. According to the first, data/information is given a highly abstract treatment through a cluster of related assumptions which describe a universe of discourse in which the concept is defined in terms akin to that of energy in classical Newtonian mechanics. In the first instance, the terms data and information are used interchangeably and are either undefined explicitly, e.g. (Gorry & Scott Morton 1971; Daft & Lengel 1986), or else defined in terms of "that which is perceived by the senses, such as words and numbers" (Huber 1982), the meanings of which are unproblematised. Building on this initial assumption, information is held to possess a number of inherent attributes and properties, two of which are of fundamental importance to the logic of this interpretation. Firstly, it is held that it is in some way quantifiable, hence making meaningful such notions as 'amount of information', 'information intensity', 'extent of information search' and 'information overload'. While secondly, what might be called the 'powerful particulars' of information are said to reside in the fact that information reduces uncertainty. In common with the second perspective discussed below, this relationship is asserted on the basis of a mathematical definition of information as given in statistical information theory, where "information has a very precise meaning. It is the average number of binary digits which must be transmitted to identify a given message from the set of all possible messages to which it belongs" (Davis & Olson 1974, p. 203). That relationship, furthermore, is held to be "direct and positive [...] the greater the level of uncertainty [...] the greater the need for external information to cope with the organizational implications of that uncertainty" (Roberts & Clarke 1989). On the basis of these related assumptions, the concept has been logically connected to decision making processes in organisations (Gorry & Scott Morton 1971), to message routing in organisations (Huber 1982) and to processes of uncertainty and equivocality reduction in organisations (Daft & Lengel 1986). Significantly, though, the nature of the world defined on these assumptions is such that uncertainty and equivocality are held to be "two forces which influence data processing in the organisation" (Daft & Lengel 1986) (present authors emphasis). While inasmuch as information is defined, in a circular fashion, as the inverse of uncertainty, this suggests that information may be thought of as a countervailing third 'force' emanating, like the other two, from the environment. This perspective corresponds to what Stamper (1985) has referred to as the 'mystical fluid' view of information in field of IS research and Langlois (1982) as the 'info-fluid' view in the fields of economics and information science.

The second perspective evident in the literature is more closely related to the actual development and management of information systems at the organisational level. On this view, information is regarded as data which has been processed in order to acquire structure and meaning. According to Alter (Alter 1992, p. 81) "we convert data into information based on our accumulated knowledge about how to format, filter, and manipulate data to be useful in a situation". While data, on this view is said to consist of "non-random symbols which represent quantities, actions, objects, etc.." (Davis & Olson 1974); or "unstructured facts" (Avison & Fitzgerald 1988). Crucially, whether unstructured or non-random, data, i.e. facts/numbers, are held to be "products of observation" (Ackoff 1989), "whereas information has a meaning and use to a particular recipient [...] data are not interpreted". (Avison & Fitzgerald 1988). On this view, furthermore, the relationship between data and information is considered to be that of "raw material [...] like metalic ores [to] finished product" (Davis & Olson 1974). In contrast to a view of information as a quasi-mystical fluid, then, this perspective may be said to offer a quasi-alchemical, and technologically mediated, alternative. And while these two perspectives differ in terms of the level of abstraction at which the concept is considered, they nonetheless share the central premise that data/information, on the former, or data, on the latter, represent atomistic 'facts' about reality, or else a natural 'force', and, furthermore, that whether facts or force the basic meaning of data/information is unproblematically given to anyone observer, and that the powerful particulars of such data/information is that it reduces (mathematically 'bounded') uncertainty.

Systems

If we now turn to the dominant conceptual practice as regards systems in the IS literature, a notable feature in most definitions is that little if any distinction is made between 'system' as a concept and 'system' as a label for some real-world objects. Consequently, and in keeping with the assumption about information noted above, systems are presumed to exist objectively, Davis and Olson (1974) for instance, list six putative real-world systems by way of an ostensive definition of the concept. On the basis of this initial assumption, or, more precisely, ontological assertion, a 'system' is variously defined in terms of lists of systems ideas which, though often random, may include, more or less comprehensively, the following features.

At its most basic, a system is said to consist of input, process, and output, i.e. a black-box. Indeed, in conjunction with an atomistic interpretation of information an IS is overwhelmingly considered to be a 'system', however defined, which essentially transforms input, i.e. data, into output, i.e. information. On a more elaborate definition, a system is defined in terms of a "whole composed of two or more subsystems" (Nolan & Wetherbe 1980, p.3); "each system is composed of subsystems which in turn are made up of other subsystems" (Davis & Olson 1974, p. 271). A (sub-) system is further characterised by its boundary which is said to separate it from the environment in which it operates. It may be noted, though, that given the prior objectivist assumption, a system's boundary is either assumed to be simply "identifiable" (Nolan & Wetherbe 1980) or else it is defined in an essentially circular fashion: "the boundary of a system defines what is inside the system and what is outside" (Alter 1992); "the features which define and delineate a system form its boundary" (Davis & Olson 1974). One of the most characteristic feature of a system, however, is said to arise from the fact that it consists of "a set of elements which operate together to accomplish [..] a common purpose, goal, or objective" (Davis & Olson 1974), "a system's purpose is the reason for its existence" (Alter 1992, p.45). While the most crucial feature by virtue of which a system, so defined, is said to be able to pursue its goals or objectives is through the operations of some cybernetic negative feedback mechanisms whereby actual output/input is compared against a standard and where any discrepancy between the two brings about appropriate actions to bring the former in line with the latter. On this definition, the term systems is then generally applied to physical and biological entities, individuals, organisations and, of course information systems.

On the basis of these assumptions about systems and information, historically, as Checkland (1990, p. 307) has argued, "from the 1960s to the 1980s organizations [have been] conceptualized as goal-seeking machines and information systems [as] there to enable the information needs associated with organizational goals to be met". It is notable, though, that on the basis of these prevalent ontological and epistemological practices "the IS literature does not currently support reliable generalizations about the relationships between [ICT] and organisational change" (Markus & Robey 1988), that existing findings have been characterised as "sketchy, scattered and sometimes dubious" (Boland & Hirschheim 1987) and that as regard IS practice the evidence suggests that IS developments are more often than not beset by quality and productivity problems (Flynn 1992), and, significantly, that the most important source of these problems can be traced back to "the social and conceptual aspects of the IS" (Lyytinen 1987a).

A Critique

The dominant assumptions about data/information and systems identified above may be characterised in terms of their twin commitment to the principle of ontological 'atomism' and to that of epistemological 'empiricism'. These two principles have been widely held to form part of the essential tenets of social scientific practice for over a century and they may be said to hang together into what Greenwood (1991, p. 1) has referred to as the 'me and Newton' syndrome. The philosophical underpinnings of each of these principles are in fact at the core of the current extensive and fruitful epistemological and methodological debate about the nature of knowledge (see, for instance, Blackler 1993; Reinhardt 1994) and in particular that of social scientific knowledge (Tsoukas 1989; Greenwood 1991; Sayer 1992; Marsden 1993). In the course of this debate, however, these two principles have come under repeated assaults and, at the philosophical level at least, they would appear to have been comprehensively challenged. Given the breadth and depth of the arguments which form the substance of this debate, only the most salient features can be highlighted here as they relate to the dominant conceptual practices with regard to information, systems and, hence information systems.

Firstly, then, the commitment to the principle of 'atomism', the cornerstone of the Newtonian world-view, whereby the world is thought to consist of "discrete atomistic elements existing as discrete, distinct points in time or space"(Sayer 1992, p. 155). While the philosophical arguments embracing the principle of atomism have been pursued to their ultimate limit in the form of logical atomism, which "proposed to construe every entity in the world other than sense-data as a logical construction" (Scruton 1984, p. 278), this principle may be said to have encountered in pure philosophy the same fate as it has in physics. Thus, as regards the latter, supposedly indivisible hard bits of 'matter' have dissolved into "a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole" (Heisenberg 1958, p. 95). While as regards the former, supposedly indubitable hard bits of logical 'truth' have dissolved into "a human artefact [...] the starting point [of enquiry] has become, not the immutable abstractions of a logical ideal, but the fallible efforts of human communication" (Scruton 1984, p. 279-280).

In relation to IS theory, as noted in the previous section, the principle of atomism translates into the idea of a basic 'unit' of 'information' or 'raw data' in terms of which quantity of information can be measured. As Roberts & Clarke (1989) have argued, however, a critical analysis of the imputed attributes of information "conceived in terms analogous to physical objects" reveals that they "all lack specificity and the capacity for practical application", most notably the notion of 'amount of information' upon which many of the others rest. To put it simply, in what units should, for practical and theoretical purposes, information be measured; number of bits of paper; inches of computer print-outs; number of computer screens; mega/giga/tera-bytes of hard disk space? An appeal the 'very precise' definition of information in the mathematical theory of communication does nothing to resolve the problem. Notwithstanding the difficulties attendent to specifying, in an open environment, the total a priori universe of possible messages to which a given message might belong and in terms of which its meaning may be logically deduced, in fact on such a definition "the measures of information content have to do with the frequency of occurrence of symbols, nothing at all to do with what they symbolize" (1981, p. 91) . Thus, while these measures do relate to some important physical aspects of information, with non trivial resource implications, they can be said to deal only with the empiric, and to varying degrees with the syntactic, aspects of information and communication but not with their semantic, including conceptual, and pragmatic, including social, aspects which, as we saw, are all important in the IS context. Thus, although "the idea is deeply rooted that information is a packet complete in itself which only needs to be transmitted", as Vickers (Open Systems Group 1984, p. 44) wrote, "in fact, information is an incomplete concept. It implies a receiver -in human contexts a mind- to be informed and its effects is wholly dependent on the interpretative systems which structures that mind and which alone determine what meaning, if any, the information shall have.[...] this system, so far from being a datum, changes constantly with time. Much communication is directed solely to changing it and still more has this for its chief, if undesigned, effect".

Another significant implication of the principle of atomism, is that by virtue of its logic it yields an essentially 'flat' or 'one-level' ontology. Not only does such on ontology fail to provide the basis for a practically adequate formulation of the concept information, as argued above, but it also renders the notion of systems unintelligible. On this account, as Sayer (Sayer 1992, p. 155) has argued "being atomistic [...] basic elements have no internal structure or differentiation". For theoretical purposes, then, any relations between atomistic elements are contingently, i.e. externally, given. The concept system, however, predicates the existence of internal relations between elements such as to give rise to a system's emergent properties. As discussed in greater details in the next section, the existence of emergent properties which cannot be explained in terms of the 'laws' which contingently relate atomistic elements, is the justification for conceptualising such an entity as a 'system' in the first place.

Secondly, the commitment to the principle of empiricism, or objectivism, according to which "valid knowledge is directly derived from sense-data and experience" (Gill & Johnson 1991, p. 165). In relation to IS theory, as in general, this principle is in fact closely related to the previous one in that it is atomistic 'facts', e.g. "words and numbers" (Huber 1982, p. 141), which are taken as given and unproblematically accessible to observers through direct sense experience. An initial argument casting doubt on this assumption may be made by reference to the evidence regarding IS development practice. Thus, if data/information were to consist of objectively given atomistic facts, these should be readily referenced by IS end-users and IS analysts alike. Yet, it is arguably the case that "by far the most significant problems in IS development efforts and the most costly to put right occur at the 'information requirement analysis' phase" (Flynn 1992); the "particularly intractable data-processing problem: how to successfully elicit, specify and structure user information requirements" (Klein &

Hirschheim 1987). If we are to avoid the conclusion that IS end-users or analysts, or both, suffer from chronic deficiencies in apprehending objective atomistic facts, then we must accept that the nature of these facts, and hence of data/information, is more problematic than it is generally thought to be.

Although the philosophical arguments which underpin a critique of the principle of empiricism are complex, they essentially concern the fact that on an empiricist account, sensations and cognition are held to be homogeneous, i.e. that the meaning of words, and numbers, i.e. 'facts', correspond to objective entities which are apprehended by a subject through sensory experience and known to her/him by reason of a correspondence between patterns of sensory experience and private mental images, i.e. words, numbers, etc. ... The most famous argument advanced against this account of knowledge was developed by Wittgenstein (1992), in his latter work, in the form of the 'private language argument', which Scruton (1984, p. 282) summarised as thus: "Suppose the theory were true. Then we could not refer to our sensations by means of words intelligible in a public language. For words in a public language get their sense publicly, by being attached to publicly accessible conditions that warrant their application. These conditions will determine not only their sense, but also their reference. The assumption that this reference is private is incompatible with the hypothesis that the sense is public. Hence, if mental events are as the Cartesian describes them to be, no word in our public language could actually refer to them"!

A commitment to the principles of empiricist and of atomism, then, leads to an account of knowledge, information or data in terms of atomistic words, numbers etc.. which in fact presupposed the very language in terms of which such an account is given, i.e. words, numbers etc. together with their meaning. The crucial implication of this argument, for the purpose of this discussion, is that knowledge, information or data, does not simply exist 'out there'. The 'meaning' of concepts, words, numbers etc. is not to be found in atomistic 'lumps' of meaning accessible to all through private mental images, nor is it to be found in atoms of formal logical truth, but in the public practice of utterance, i.e. processes of communication, in which language, words, concepts and information, are created, maintained and modified through the practices which they sustain and which sustain them. As Scruton (1984, p. 284) has argued, we "do indeed inhabit an objective world, a world where things are or can be other than they seem". However, any claims to knowledge about this world can only be made in terms of publicly intelligible language, i.e. concepts, words, numbers, and of a standard of correctness which regulate the use of that language. This standard, as Scruton argued, "is not God-given, nor does it lie dormant in the order of nature. It is a human artefact, as much the product as the producer of the linguistic practices which it governs". This position, it may be noted, is entirely consistent with that adopted in modern physics. Thus, as Heisenberg (1958, p. 46) wrote "we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning. Our scientific work in physics consists in asking questions about nature in the language that we possess [...]".

The thrust of the argument so far has been to bring under critical scrutiny the conceptual language that we possess in the IS field and in terms of which we ask questions about 'Information Systems'. To summarise the argument: an empiricist epistemology grounded in an atomistic ontology does not yield practically adequate definitions of information and data, and indeed of systems, in the IS context, nor do they do so with respect to knowledge generally. It is clear, furthermore that any suggested alternative will have to be able to sustain an account of its key 'thought objects', i.e. information, systems and, hence, information systems in terms of their ontological depth, i.e. emergent properties together with an account of information as an artefact, i.e. the "product of human art and workmanship" (Sykes 1982, 48),

Information and Systems: An Alternative

Whilst the alternative ontological and epistemological assumptions outlined above stand in sharp contrast to those sustaining the current orthodoxy in IS research, the basic conceptual elements upon which such an alternative may be elaborated are already well developed individually though they remain to be integrated in the context of IS theory. These elements can be found in; Semiotics, the theory of 'signs'; and Systems, the theory of 'wholes' in its modern, i.e. systemic in contrast to systematic, form. And although the concepts information and systems were considered in this order in the previous sections, it will be useful at this stage to consider them in reverse order.

Systems

Systems theory is concerned with "the attempt to map the concept of wholes onto what we perceive as complex happenings in the real world." (Checkland 1992, p. 1029). In the first instance, the concept system implies, at least, one observer who for descriptive, predictive and/or constructive purposes defines an entity as a coherent whole in such a way as to make it meaningful to draw a boundary between that entity and hence distinguish from its environment. Such a whole-entity may be physical or abstract and can be characterised in terms of properties, e.g. structures and behaviours, which are not deducible from the 'laws' or principles which determine the properties of its constituent parts individually. As already noted, such emergent properties are to be explicated by reference to the internal relations which obtain between that system's elements or parts. And it may be noted that while the existence of emergent properties imply that a system is 'more than the sum of its parts', the conditions necessary for a system to be thus are such that a system is also, necessarily, less than the sum of its parts. As Vickers wrote in relation to the types of systems of specific interest to this discussion, "the organized constituents of human systems can do what they could not do otherwise; but they cannot do some things which, unorganized they could do" (quoted in Open Systems Group 1984).

The above premise leads to a Systems view of complex systems where it is held that "there exists a hierarchy of levels of organization, characterized by emergent properties which do not exist at the lower level. Indeed, more than the fact that they 'do not exist' at the lower level, emergent properties are meaningless in the language appropriate to the lower level [...] Emergent properties associated with a set of elements at one level in a hierarchy [...] are associated with what we may look upon as constraints upon the degree of freedom of the elements [...] The imposition of constraints upon [properties] at one level which yield [properties] meaningful at a higher level, is an example or regulatory or control action. Hierarchies are characterised by processes of control operations at the interfaces between levels." (Checkland 1981). Essentially, and in contrast to a flat atomistic, or Newtonian, ontology, a system conceptualised in terms of layered structure of emergent properties and languages in terms of which these may be described, implies that "neither a one level epistemology nor a one level ontology is possible" (Broad (Broad 1923), cited in Checkland 1981, p. 78). While at a practical level, it implies that "the ultimate aim [of systems theory] must be to provide both an account of the relationships between different levels and an account of how observed hierarchies come to be formed: what generates the levels, what separates them, what links them?" (Checkland 1981, p. 81).

Several important issues arise with respect to the concept systems as defined above. As with all other concepts, "the most significant is [...] making clear the relation between the epistemology of the subject area [i.e. systems] and the ontology of the perceived world with which it is concerned"" (Checkland 1992, 1026). This issue comes to the fore most clearly with regard to the crucial distinctions which can be made between natural and human-based systems, e.g. information systems. It was noted above that the systems ideas in terms of which an information system is generally defined in the IS literature are indiscriminately applied to all types of systems, and, furthermore, that out of a commitment to the principle of empiricism such systems are assumed to exist 'out there'. It must be recognised, however, that whereas specifying the boundaries and emergent properties of natural systems cannot be said to be sensitive to differences in individual beliefs and points of view -even the wave-particle duality is an indisputable empirical fact!- specifying the boundaries and emergent properties of human-based systems is, by contrast, crucially dependent on such differences. This issue we would argue is particularly significant with regard to the IS development process. The latter, as Lyytinen (Lyytinen 1987b, p. 6) has suggested, may be defined as "a change process taken with respect to object systems in a set of environments by a development group to achieve or maintain some objectives". Significantly, as Lyytinen argued, "it is currently realized there are no objectively given object systems. Rather people have viewpoints which enable them to perceive object systems [...] wholes with emergent properties. In the beginning change is conditioned by the initial perception enabled by the language used. However, during the development process language and perceptions are in constant flux". Thus rather than involving the simple collection and formalisation of unproblematically given data, the IS development process can be said to involve a generative process of 'information' or language construction.

Another important issue arises with respect to the notion of a system's goal, purpose or objectives, and the mechanisms of regulation, or control, in terms of which systems behaviour may be modelled. According to the definitions reviewed above, systems are held to be goal seeking, i.e. goals, purposes and objectives are inherent in, objectively given, systems. This we argue is an unjustifiable reification. Physical, biological or computer-based 'systems' cannot be said to be purposeful in an by themselves. Even in the case of purposeful human activity systems, such as these may be defined for management purposes, goals and objectives are attributable only to the humans involved in defining what the system 'does', i.e. 'is', or 'should do', i.e. 'should be'. The assumption of goal-seeking behaviour, furthermore, can be criticised for its 'poverty-stricken' view of human psychology. Thus, as Vickers has argued, "The goals we seek are changes in our relations or in our opportunities for relating; but the bulk of our activity consists in the 'relating' itself. [...] To explain all human activity in terms of 'goal-seeking', though good enough for the behaviour of hungry rats in mazes, raises insoluble pseudo-conflicts between means and ends (which are thus made in-commensurable) [e.g. the enduring 'alignment' problems between business and ICT strategies!] and leave the most important aspect of our activities, the ongoing maintenance of our ongoing activities and their ongoing satisfactions, hanging in the air as a psychological anomaly called 'action done for its own sake'" (1983, p. 212, original emphasis).

With respect to modelling the behaviour of human-based systems, Vickers further argued that while the analogy of the cybernetic feedback loop may be useful in modelling executive decision making, i.e. "in situation[s] in which 'policy' is taken as both 'given' and feasible" it is inappropriate for modelling institutional behaviour where one must account for "the evolution, modification of the course, the norm, the governing relation which is inherent in every policy and the selection and ascertainment of the facts [i.e. information] relevant to it". At the core of this process is what Vickers has named Appreciation whereby institutional relationships, both internal and external, are maintained, modified, eluded or created, though time. Appreciation, more specifically, involves making three kinds of judgments: 'reality judgments', i.e. judgment of fact about the 'state of the system'. It also involves making value judgments, i.e. judgements "about the significance of these facts to the appreciator. [...] Judgments of value give meaning to judgments of reality, as a course gives meaning to a compass card" (Vickers 1983, p. 40). In institutional contexts, moreover, 'value-reality' judgments are not exercised for their own sake but in turn lead to 'instrumental judgments', or executive decisions regarding the appropriate course of action. On this reading, then value, reality and action judgments are inseparable as they unfold through time. Crucially, though, the standard, or more generally a system's 'appreciative setting', by which value judgment are made at any one point in time is the product of a prior exercise of value judgment, i.e. of the history of the system, while any exercise of value judgment in turn reinforces or modify the standard by which future judgments will be made (see Checkland & Casar 1986 for a systemic account of Vickers model). As such, therefore, the behaviour of relationship maintaining appreciative systems cannot be accounted for in terms of a cybernetic goal-seeking open system model but rather in terms of the model of an autopoietic' system (Maturana & Varela 1980). Autopoietic systems "are organised in such a way that their processes produce the very components which are necessary for the continuance of these processes [...] They do not primarily transform input into an output except in the sense of transforming themselves into themselves" (Mingers 1989). The particularly significant theoretical implication of this model for the purpose of this discussion is that it leads to a view of institutional systems, in terms of their organisational logic, as "consensual domain of behaviors (including above all language and description) which are both arbitrary and context dependent" (Mingers 1989).

'Informaction'

A consequence of the arguments developed in the previous section, as will be recalled, is that the concept information has been problematised; knowledge/information is not a physical or a logical 'given' but a human artefact. And to the extent that information and action are ultimately inseparable we would suggest the term informaction as a better descriptor of the concept. For practical purposes, however, if 'informaction' does not consist of objectively given informational atoms, then what can we take as given, and how do we conceptualise this key 'thought object'? With respect to the first point as Stamper (1987, p. 45) has argued, "you cannot show people information except in the simple sense of a collection of signs; so why not begin there"? While with respect to the second point, Semiotics, or the theory of signs can be seen to provide the means with which to account for the 'requisite' dimensions of 'informaction' discussed above and "allows us to bridge the man-machine boundary with strong unifying ideas" (Stamper 1987, p. 45).

Although signs do undoubtedly take a great number of possible forms these nonetheless share at least two basic characteristics; they are essentially arbitrary at their point of origin, i.e. alphabets, mathematical notations or database schema notations are not God-given but human-made; and they are both the product of and the medium for human communications in the face of practical situations, e.g. developing an information system or a theory about information systems. Signs and their meaning-in-use, may be understood in terms of four levels corresponding to the four "major branches of semiotics: pragmatics, semantics, syntactics and empirics" (Stamper 1987, p. 45). As Liebenau and Bakhouse (1990, p. 13) have argued, "the entire structure presupposes that responsible agents, which might be individuals, groups, or larger organizations, have commitments, expectations and relations within social frameworks. These reflect the ability of actors with thoughts to have an effect upon the world". These four levels, which we would argue may be thought of in terms of emergent properties, may be briefly summarised as follows, as they relate to IS conceptualisation, analysis and/or design.

At their most basic, signs may be described at the level of their empirics, i.e. their physical characteristics, including that of the medium used in their communication. At that level, attention "focuses upon the very limited set of questions about the repeated use of signs [in] statistical terms" (Stamper 1987, p. 45), what has become known, regrettably, as 'information theory'. In relation to IS, empirics is essentially concerned with the computing and communication hardware and the actual signals generated by software instructions at the machine-level. The second level, syntactics, concerns the formal rules which govern the use of signs. "By formalizing we provide rigor to the use of language by the constraints of vocabulary, grammar and the rules which govern them" (Liebenau & Backhouse 1990, p. 55). With respect to IS, this level is concerned with database schema and the rules of integrity, consistency and validity governing the use of signs within such schema. The third level, i.e. semantics, "deals with the issue of meaning, the relationships between signs and what they purport to represent" (Stamper 1987, p. 45). i.e. their referent. As Liebenau and Backhouse (1990, p. 44) have argued, "what is crucially different here from commonly held notions of meaning is the rejection of the idea of an intrinsic meaning to a sign, and its replacement by a model which relies upon two agents or groups interacting in a complex exchange whose effectiveness is tested in the actual behaviour of the parties involved". With respect to IS, the semantic level of signs will involve "agreeing upon boundaries, identifying individuals, establishing and maintaining classifications, conjecturing ways of doing things that belong in no existing schema." (Stamper 1987, p. 57). The fourth level at which signs-in-use must be understood, i.e. pragmatics, is concerned with "the context of activity, and those characteristics of people, organizations and acts of communication which affect information" (Liebenau & Backhouse 1990, p. 20). With respect to IS, this level is concerned with the cultural context and norms, i.e. perceptual, cognitive, evaluative, behavioural and denotative, and with the intentionality of organisational agents in terms of which the 'meaning' of signs-in-use may be specified.

Summary and Conclusion

In this paper we have presented a critique of the atomistic ontology and empiricist epistemology which inform most current definitions of the concepts information, systems and, hence, information systems in the Information Systems (IS) literature. The notion of information as an objectively given quantifiable 'force' emanating from the real world and endowed with the essential property of dissolving uncertainty; or as possessing the same essential property but as consisting of structured or processed data, i.e. atomistic 'facts', about the real world have been argued to be unsustainable, on both philosophical and practical grounds. It has been argued, furthermore, that the notion of systems as an ontology in respect of goal-seeking cybernetic machines unproblematically specifiable in terms of their boundaries, of their input and output, and of their objectives is not only inappropriate to the socially-based systems in terms of which an IS must be defined, but also fails to consider the ontological, and consequently epistemological, depth implied by this concept. In view of these arguments, an alternative conceptual practice has been explored by suggesting that the concept system be taken as an epistemological tool to be deployed in respect of complex coherent 'whole-entities' characterised by their emergent properties and, in the case of socially-based systems, by the essential autopoietic nature of their modes of regulation and self-representation including, above all, language. It has also been suggested that information or, more appropriately 'informaction', be considered as a set of, fundamentally, arbitrary signs whose 'emergent' properties, i.e. syntactic, semantic and pragmatic, are intersubjectively negotiated between intentional organisational agents and, as such, inseparable from the forms of social life which they sustain and in which they are generated.

Conceptualising informaction as an autopoietic system of signs with emergent properties through which they mediate intention, meaning and action offers, we suggest, several related advantages. At a theoretical level, this alternative conceptual practice provides an initial framework in which to ground the currently ill-defined, "emergent perspective" on the relationship between ICT and organisational change, identified in the IS literature by Markus and Robey (1988). Such a framework, furthermore, is congruent with recent developments in the concept of organisational knowledge as "situated performance rather than abstract representation" (Pentland 1992, p. 527) and as 'activity systems' in which "practical actions are located in a process which is recurrent, systemic and self organizing, rooted in history and reaching out to the future" (Blackler 1993, p. 875). At the methodological level, it is also congruent with recent developments in field of Computer Supported Cooperative Work and "the dawning recognition of the socially organised character or work as a condition of system design" and where "substituting a 'waterfall' model of design [...] with a 'spiral' model, in which a virtually continuous process of redesign while the system is in use in envisaged" (Randall et al., 1991, p. 20). While at the practical level, this spiral model of IS development is in fact highly compatible with the object oriented paradigm which is currently attracting increasing practical attention in terms of IS development methods, database management systems, programming languages and operating systems (Heintz 1991; Kagan 1992; Taylor 1992). This paradigm, would seem to offer distinct technical advantages (Kagan 1992; Lewis et al., 1992; Taylor 1992), not least of which their greater suitability for dealing with increasingly complex multi-level and multi-media data structures and of the group-work characteristics of ICT applications in organisations. Crucially, perhaps, in contrast to the procedural approach to software development and data-driven IS development methods in which data/information and actions, or behaviour, are kept strictly separate, i.e.. data/information are stored in a database and are 'acted upon' by application programs, in the object oriented paradigm, information and action are brought together into meaningful whole entities, i.e. complex objects. This paradigm, we would suggest, provides a more flexible, reusable and maintainable context dependent systems 'language' which is more meaningful in terms of its semantics and empirics, and which as such opens the prospect of, in some significant measure, bridging the gap between IS end-users, developers, and indeed researchers.

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