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Towards an Autopoietic Perspective on Knowledge Management

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Abstract

The field of Knowledge Management promises considerable benefits to organisations attempting to manage their intellectual resources, but what is the basis for this claim? In this paper it will be argued that unless the field of Knowledge Management (KM) first addresses the fundamentals of that which it claims to manage, it runs the risk of being discarded as just another failed management fad that promised much but delivered little. It will be argued that autopoietic theory, as developed by Maturana and Varela (1980), offers a useful epistemological basis from which KM may develop as a discipline.

Keywords

knowledge management, knowledge management systems, research issues in knowledge management, autopoietic theory

INTRODUCTION

Knowledge management, as a field of study, suffers from a potentially paralysing identity crisis. Put simply, what is it that everyone is trying so hard to manage? In this paper we review a range of literature relating to discussions of knowledge within organisational contexts, in order to draw attention to the inconsistencies that exist in current approaches to the discussion of Knowledge Management (KM). It will be argued that unless the field of KM first addresses the fundamentals of that which it claims to manage, it runs the risk of being discarded as just another failed management fad that promised much but delivered little. The field of KM has the potential to bring considerable benefits to organisations attempting to manage their intellectual resources, but arguably the basis for this claim rests on shaky ground unless a consistent model that distinguishes between knowledge, information and data can be established.

In an attempt to address the observed inconsistencies we explore the use of Maturana and Varela's (1980) autopoietic theory as a basis for the development of such a model. Autopoiesis is a biological systems theory and has significant implications for cognitive science and the way in which knowledge is considered. A range of authors (von Krogh and Roos, 1996; Mingers, 1995) have also noted this potential and discussed the use of Maturana and Varela's autopoietic theory as one avenue through which the fields of KM and Information Systems may address the inconsistencies that have emerged. This paper should not be considered, however, as an attempt to provide the definitive position on this topic, nor is it an attempt to be comprehensive in terms of the full breadth of KM literature as new titles within the KM field are published daily (MacMorrow, 2001). Rather the purpose of this paper is to highlight the issues associated with uninformed and ill-considered applications of past theories and to provide a new perspective from which practitioners may develop or consider their own working definitions of knowledge. A point noted by Fahey and Prusak (1998) is that a common mistake made by practitioners is to not have a working definition of knowledge as the basis for their initiatives.

The focus in this paper will be on the work of organisational theorists and the philosophers who underpin their writing. It should be noted, however, that there is a vastly wider range of work on knowledge that could also be included. The work in the Eastern philosophies regarding the nature of knowledge and wholeness will not be discussed here, nor will the

extensive discussions on the nature of scientific knowledge (Oliver-Martin, 1957). Considerable research has also been done within the various areas of educational theory regarding disciplinary (Alexander, 1992), professional and propositional (Higgs and Titchen, 1997) forms of knowledge.

The paper is structured in three parts. The first part examines some of the issues involved in developing a coherent model for KM and how these have been approached within the literature; Secondly, it provides a brief overview of autopoietic theory, and finally it examines the implications autopoietic theory may have for the development of a coherent model of knowledge, information and data, in the context of KM.

TOWARDS A CONCEPT OF KNOWLEDGE

In order to discuss what might be meant by the notion of knowledge in an organisational context, there are several issues that must be dealt with before practical solutions may be considered. Primary amongst these issues is the identification of how knowledge may be conceptualised. In addressing this issue it should be made clear that the subject is being viewed from a Western cultural perspective, and therefore some of the conclusions with regard to various concepts may be seen as limited from other cultural perspectives. A critical issue is that knowledge is difficult to clearly define; it is a word that in common usage has several different meanings and has therefore become a difficult focus for study. A brief examination of the etymology of knowledge produced the following lucid explanation: "This word has had a vigorous life" (Oxford English Dictionary, 1989).

The ambiguity associated with knowledge is exacerbated in the organisational context, through its relationship to the concepts of information and data. On the subject of knowledge management many authors such as Walsh and Ungson (1991), Allee (1997) and Davenport (at least in his earlier work) (1997) use the words knowledge and information interchangeably, implying that they mean the same thing. This interchangeability creates considerable confusion if one is to develop and implement a KM strategy in an organisation and it could be argued it devalues the meaning of the term 'KM'. The reason for this is that the mode by which knowledge is retained, shared, identified, located, accessed and used, changes dramatically according to how the notion is defined. It is therefore necessary to spend considerable time analysing the notion of knowledge, examine the way in which it has been defined, and identify the forms it and other closely associated notions, such as information, may take.

Within organisational research, there would appear to be 3 main streams of study relating to knowledge and its management (von Krogh and Roos, 1996). The first of these streams conceives of knowledge as an object. This stream is often associated with information science and information markets. von Krogh and Roos, (1996) refer to this stream as the 'Information Processing Epistemology'. The key focus of this research is the codification of knowledge into units of information that can be easily moved, sold or attributed value in some form. The second stream of research views knowledge more as a process and is concerned with the behavioural aspects of organisational life and their effect on the retention and transfer of knowledge throughout the organisation. von Krogh and Roos, (1996) refer to this as the 'Network Epistemology'. Initiatives in this stream usually relate to the different ways of connecting people around the organisation, again information systems often play a central role as supposedly the most cost effective means by which this can be achieved. The use of information systems has drawn some criticism from information professionals (Reimus, 1997; Battles *et al.*, 1996; McDavid, 1996), however, with the recognition that there is more to the management of knowledge than the movement of information.

A third stream, identified by von Krogh and Roos, and termed by them as the 'Self-referential Epistemology' is markedly different from the two above and assumes that knowledge is a "...private, history dependent process in each one of us". This view of knowledge has received very little attention in the literature, however, its assumptions are drawn from cognitive science and autopoietic theory in particular. Consequently, this view will be discussed in more detail later in this paper.

Perspectives on KM

The three research streams described above have given rise to a number of different perspectives on knowledge management, each with its own focus and disciplinary background. Alavi and Leidner for example identify 5 perspectives “(1) a state of mind, (2) an object, (3) a process, (4) a condition of having access to information, or (5) a capability” (2001:109). Within their analysis, each of these perspectives more or less sit beside each other as different views of knowledge but are not explicitly linked to clear sets of epistemological or ontological assumptions by which they may be understood. We would argue that by aligning the different perspectives to the assumptions that underpin them, a less cumbersome way in which to consider these different perspectives emerges. There are essentially two distinct dimensions that have been discussed. The first is epistemological in nature and refers to the first two streams of knowledge research: knowledge as an object and knowledge as a process. The second dimension is ontological in nature, with knowledge as a quality of the individual at one extreme and knowledge as a social quality at the other. It is possible to overlay these two dimensions and consequently produce a four-focus model for the examination of KM at least within the first two research streams described by von Krogh and Roos.

The four perspectives produced by the model, shown in Figure 1, have corresponding research foci that we have termed Information Processing, Patents/ Intellectual Property, Innovation and Collaboration, and Organisational Capability. Each of these foci is described below:

Information Processing: this perspective results from the assumption that knowledge is a characteristic of the individual and is best conceptualised as an object. The focus of this quadrant is the development of information technology solutions or knowledge management systems (KMS). In particular the codification of knowledge into database formats that can then be accessed electronically.

Individual Performance and Innovation: results from the intersection of viewing knowledge as a quality of the individual, and knowledge as a process. The focus here is on increasing the individual performance of the employee through providing a work environment conducive to KM. This is perhaps the most complex of the four research foci and includes organisational structure, industrial relations and information technology issues within it.

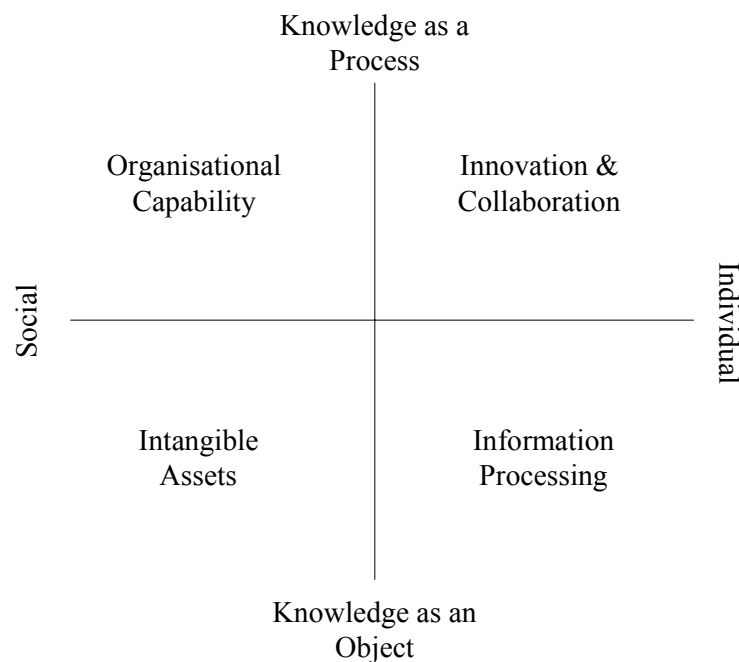


Figure 1: Knowledge Management Perspectives

Intangible Assets: This perspective results from the intersection of knowledge as an object, and viewing knowledge as a quality of the organisation overall. For example, intellectual property and patents are viewed as belonging to organisations as entities with an ontological status and having a measurable value in the sense that they may be sold.

Organisational Capability: This view adopts the position that knowledge is a quality of the organisation and, consistent with the second research stream, is best viewed as a process. The focus of this perspective is the competitive advantage that an organisation may have, with the assumption that the whole has capabilities not found in the parts.

The overwhelming majority of research and discussion in relation to KM takes place within the four perspectives created by the overlap of these sets of assumptions. Although each of these perspectives provide arguably useful insights regarding the way in which knowledge may be studied in organisations, we would argue, that together do not provide a particularly coherent framework for the analysis of the topic. The relationships between the different perspectives or foci are arguably tenuous as they lack a coherent basis through which they may be understood and combined. In order to understand our concerns in this regard, a brief historical overview of the literature is provided in order to explicate the problems.

THE WORK OF MICHEL POLANYI

Perhaps the most celebrated thinker on the notion of knowledge (at least within the KM field) is Michel Polanyi. Polanyi, originally a medical doctor, turned to philosophy relatively late in life, writing two major works on the topic. The most detailed of these was *Personal Knowledge: Towards a Post-Critical Philosophy* (1958). The main focus of this work was to establish the basis of scientific knowledge and through this exploration develop an epistemological perspective on the problem. His second major work is the much lighter *Tacit Dimension* (1967), which is a collection of lectures given at Yale University. Polanyi's work is extremely significant to KM as it has been quite influential in terms of guiding the research of more contemporary management writers. For example, Nonaka, in various collaborative articles (1994; *et al.*, 1994) and a book (Nonaka and Takeuchi, 1995) on the topic, adopts Polanyi's tacit/ explicit distinction as the basis for further theoretical developments. Sveiby (1994; 1997) also adopts this distinction in his discussions of knowledge-based assets. Each of these authors, focus their attention on knowledge in the organisational context, with the assumption that knowledge resides in the individual.

Although the most regularly cited aspect of Polanyi's work is his distinction between tacit and explicit knowledge, it should be made clear that Polanyi's theory goes into far more depth than this dualistic analogy. Polanyi concentrates more on the complementary relationship between what he terms focal knowledge and tacit knowledge, than the explicit/ tacit distinction. Focal knowledge refers to knowledge about an object or phenomenon that is in 'focus'; an example Polanyi uses to explain this is the hammering of a nail. In this activity it is the nail that is in the individual's 'focus'. Tacit knowledge refers to knowledge used to manipulate or relate to the object of the focal knowledge; using the above example, this could be holding and moving the hammer onto the nail. Polanyi's point is that in this process the individual would not appear to be conscious of the motion of hammering, the hammering is not an object of attention. He suggests that we have a "subsidiary awareness" (1958:55) of the hammer. According to Polanyi, people move between focal and tacit knowledge continuously as a function of living and experiencing. As such, tacit knowledge forms a background against which all the other forms of knowledge are constituted. All knowledge therefore rests in a tacit dimension (Sveiby, 1996). Explicit knowledge refers to that knowledge which people have made explicit through language. Examples of explicit knowledge may include things that are written down, communicated vocally, or via some other symbolic medium. For Polanyi, explicit knowledge represents the metaphoric tip of the iceberg in terms of an individual's knowledge, hence Polanyi's saying, "We can know more than we can tell" (Polanyi, 1967:4).

There are several key points with regard to explicit knowledge that are significant to KM. The first is that explicit knowledge can be easily shared between individuals and can therefore be added to, and built upon. The second is that because it has been codified into language it can become an object for reflection by either the individual who created the knowledge or someone else. It can also be manipulated for all intents and purposes in the same way as

information. The implication of this statement for organisations is that explicit knowledge can be shared to some extent through information systems, in contrast to tacit knowledge that, it is argued cannot be shared in this way until it has been made explicit, and therefore requires a different process of management.

Tacit knowledge, as described above, remains in an incommunicable domain. This does not mean that information relating to an individual's tacit knowledge is beyond reach, rather that it is only available through the observation of non-linguistic behavioural cues. Polanyi describes the way in which tacit knowledge is transferred from one person to another in terms of his concept of tradition. For Polanyi, tradition is represented as a system of values with which the individual acts. The system is outside the individual and facilitates the movement of a process-of-knowing from one individual to another. It is perhaps more accurate to conceptualise the process as the recreation of one person's knowledge in another, rather than the transfer of knowledge from one to another. Polanyi identifies three tacit psycho-social processes by which this movement of knowledge takes place, Imitation, Identification, and Learning by doing.

Nonaka and Takeuchi (1995), following Polanyi, developed a theory of organisational knowledge creation. In so doing they made one serious departure from Polanyi's original theory in that they discuss knowledge as both a quality of the individual and an organisation. Polanyi regards knowledge as a property of the individual and not of an organisation or social system. Nonaka and Takeuchi (1995) make the comment that strictly speaking, individuals create knowledge, an organisation cannot create knowledge without individuals and that their theory is concerned more with the process by which individual knowledge is 'organisationally amplified'. Nonaka and Takeuchi are quite clear regarding their particular ontological and epistemological assumptions. Ontologically they refer to levels of 'knowledge creating entities', i.e. individual, group, organisational and inter-organisational. This is somewhat contradictory with their original statement regarding the individual nature of knowledge. Epistemologically they are concerned with the continuum from tacit to explicit knowledge. They suggest that, "A spiral emerges when the interaction between tacit and explicit knowledge is elevated dynamically from a lower ontological level to higher levels" (Nonaka and Takeuchi, 1995:57). Through these interactions four modes of knowledge conversion are created – socialisation, externalisation, combination and internalisation. Each mode of knowledge conversion refers to the interactions of different combinations of tacit and explicit knowledge. Furthermore it is through these mechanisms that knowledge gets articulated and 'amplified' throughout the organisation.

Nonaka and Takeuchi's work has had a significant impact on the development of KM as a field, but unfortunately has not added more clarity in terms of understanding the concepts involved. To understand why this is the case, one must consider that the average KM practitioner is not concerned with examining the sources upon which Nonaka and Takeuchi constructed their model and as such are unaware that they omitted key concepts of Polanyi's original theory, which due to its constitution render the notions of tacit and explicit knowledge largely incoherent as they are not considered in context with focal knowledge and the concept of tradition described above (a point that will be explained in detail in the third part of this paper). The typology of concepts created by Nonaka and Takeuchi's work is highly questionable and furthermore blurs the distinction between knowledge and information. As Tsoukas observes,

Typologies are based on the assumption that an observer is able to discern certain systematic similarities and differences (i.e. forms) between the objects of study. That is fine, provided we are also aware of what we lose by doing so: for formistic thinking to be possible, the conceptual categories along which the phenomenon are classified must be assumed to be discrete, separate and stable. The problem is that they hardly ever are.

(Pepper, 1942 in Tsoukas, 1996:14)

Within the notions of knowledge, information and meaning, Tsoukas' caution is valid. Polanyi (1967) himself confirms the unstable nature of knowledge when he points out that tacit knowledge can be expressed linguistically if we focus our attention on it. As such tacit knowledge, under certain circumstances, can have characteristics normally associated with

explicit knowledge. A tacit dimension, on the other hand always composes explicit knowledge. Consequently tacit/explicit distinction as discussed within the KM literature is questionable due to the mechanistic division of what should be considered an indivisible whole. As Tsoukas observes: "Tacit knowledge is the necessary component of all knowledge; it is not made up of discreet beans which may be ground, lost or reconstituted. ...To split tacit from explicit is to miss the point-the two are inseparably related" (Tsoukas, 1996:14). The superficial application of Polanyi's original work has ironically had the effect of creating more confusion than clarification, with these notions now becoming taken-for-granted concepts within the KM literature and are used in everyday language when discussing issues of KM.

Sveiby (1997:37) also based his research on the management of intangible assets on Polanyi's theory. Intangible assets, as opposed to tangible ones are qualities of an organisation that do not show up on the balance sheet but none the less carry considerable value. The argument is that intangible assets, combined with the value on the balance sheet provide a more accurate understanding of an organisation's value. Sveiby's use of Polanyi's work is more consistent with the original theory and has led him to define knowledge as "the capacity to act" (1997:37), stressing that this is not an all encompassing definition, rather a practical notion for the concept. He also recognises the ambiguous nature of knowledge, "Because the word knowledge is a notion with so many connotations it is often not practical to use it" (*ibid*:35). As a result Sveiby explores the notion of competence as a more workable concept to describe the characteristics of knowledge in the organisational context. He suggests that an individual's competence is made up of five mutually dependent elements; explicit knowledge, skill, experience, value judgements and social network. Unfortunately, the ideas of tacit and explicit knowledge have done more to capture the imagination of budding KM practitioners and as such are more widely used.

A very different perspective on knowledge in organisations can be seen in the work of Frank Blackler (1995). Unlike the authors above, Blackler assumes that knowledge may be a quality of an organisation or group. He undertakes an extensive review of the literature on knowledge, somehow missing the work of Polanyi, and discussing a number of other perspectives on the subject. He actually uses the terms tacit and explicit throughout his descriptions, however, the meanings he associates with these terms are not made clear. Based on the work of Collins (1993), Blackler develops a categorisation of knowledge types, with five images of knowledge, termed embrained, embodied, encultured, embedded and encoded. Embrained Knowledge, refers most commonly to abstract knowledge in the organisation. Embodied Knowledge, is action oriented and only partly explicit. This particular form of knowledge is probably the closest of those described by Blackler to Polanyi's tacit knowledge. Encultured Knowledge, refers to the process of achieving shared understandings. Embedded Knowledge, is knowledge that resides in systemic routines. Blackler cites the work of Prahalad and Hamel (1990) on organisational competencies or core competence as an example. Encoded Knowledge, is information conveyed by signs and symbols. The issue of how knowledge relates to information or is distinguished from it does not form a significant focus in Blackler's work. Blackler doesn't comment on whether information is meaningful or meaningless, choosing to give examples that constitute encoded knowledge in everyday organisational life. In all the examples he gives, there is an implicit assumption that the transfer of meaning occurs because of some consensus regarding what the symbols in the communication mean. Blackler's work is only one example of a KM theory where knowledge is considered as a function of an organisation or group. For example Walsh and Ungson (1991) discuss the notion of organisational memory, Weick and Roberts (1993) use the notion of collective mind to describe knowledgeable acts that are attributable to a group.

The impact of the incoherences described above is particularly evident in the development of KMS. System designers, lacking a clear understanding of where these different terms have come from attempt to build systems that can manipulate, capture, store, and disseminate 'knowledge', yet arguably are doing nothing more than "bottling fog"! Without a coherent understanding of the differences between knowledge, information and data, and the way in which people interact with these concepts how is it possible to develop a system that has some hope of succeeding in its defined purpose. In the next two sections it will be

argued that there are clear differences between the two concepts of knowledge and information, and that by moving away from an interchangeable knowledge/ information framework it is possible to develop a coherent approach to the issue that can be usefully applied in the business context. To examine this further, the next section will introduce key concepts from Maturana and Varela's autopoietic theory to provide a basis for discussing von Krogh and Roo's (1996) third KM research stream – the Self-referential Epistemology.

AN OVERVIEW OF AUTOPOIETIC THEORY

von Krogh and Roos third research stream is termed the 'Self-referential Epistemology, and is largely based upon the work of Chilean neurobiologists Humberto Maturana and Francisco Varela. Their theory of autopoiesis or self-production, was developed to provide explanations of the nature and characteristics of living systems. The theory involves an idiosyncratic terminology, that in many ways makes it less accessible and requires some explanation before its potential application may be discussed. The idea that living systems are self-producing technically means that the components of the system, further produce the components of the system. The significance of this point, in terms of developing a coherent model of KM, is that processes involved in the maintenance of an entity's, or human's autopoiesis describe a unique epistemology and ontology, based upon the nature of the relationship between the individual and their environment. Although it is not possible to fully describe the various concepts and processes that compose autopoietic theory in full, it is important to describe some of the core concepts such that subsequent discussions may be understood.

Autopoietic systems are autonomous in the sense that they are self-producing, however, it should not be inferred that they survive completely independently of the environment in which they exist. Maturana and Varela account for the relationship between the system and its environment through the concepts of ontogeny and structural coupling. The ontogeny of a unity (or in the context of this paper, a person) denotes the history of structural change within that person, without the loss of its organisation (Maturana and Varela, 1992). Structural change within a unity can take two forms, either a change that is triggered by interactions with the environment in which it exists, or by its internal dynamics (Maturana and Varela, 1992). So although environmental perturbations may trigger changes in the structure of a unity, they have no control over the results of those changes. The unity persists due to its self-organisation, which is geared to the maintenance of its viability. An individual's behaviour is determined by particular states of nervous system activity (Maturana and Varela, 1980), this activity is defined by what Maturana and Varela have described as operational closure, which presupposes that in all cases nervous system activity results from, and leads to, further nervous system activity in a closed cycle. The nervous system's structure and not external forces therefore define possible and actual changes in state of the nervous system. External or environmental forces may act as triggers for change but it is the nervous system's structure that dictates which forces can be a trigger (Mingers, 1991). Therefore changes to the structure of one person's nervous system, and consequently their behaviour, will be unique to that person. The environmental perturbations that act as a change trigger in one person will not necessarily trigger a change in another, or if they do, the change that is triggered may take a different form and/ or have different implications for the viability of that person in his/ her environment, given his/ her history. Although the nervous system is operationally closed it does not have a fixed structure, it is plastic, its structure changes over time and it is this quality that allows for changes in behaviour and subsequently what we describe as learning (Mingers, 1991). Therefore as the nervous system's structure changes, so too will the potential range of behaviours that its structural-determinacy makes possible.

When considering the ontogeny of two people, the situation of structural change can be viewed from the perspective of either individual. Depending on which unity is under study, the other simply becomes a component of the environment with which that unity is constantly interacting. When these interactions become 'recurrent', autopoietic unities can become structurally coupled. Hence, there is a history of recurrent interactions leading to a structural congruence between the two unities. Therefore, a unity is structurally coupled to its environment and vice versa. Language is an example of higher-level structural coupling, or what Maturana and Varela would describe as a consensual domain. Within a consensual

domain two individuals would be able to observe the attribution of meaning to common events and experience that are extremely similar for both parties.

Within the literature on autopoietic theory there has been considerable debate over the past 20 years regarding whether higher order entities, such as social systems may be considered to be autopoietic (see Zeleny and Hufford, 1992; Luhmann, 1990; Robb, 1992; Morgan, 1997). A number of different approaches have been adopted, with none being completely satisfactory in terms of ontology, epistemology or application. It is beyond the scope of this paper to discuss these debates in detail, however, the arguments in relation to this issue have been summarised elsewhere (see Kay, 2001). In the context of this paper, we will argue that social systems themselves are *not* autopoietic, but that the processes described within autopoietic theory may be used to better understand the generative processes that give rise to organisations and other social collectives. This point is important in terms of discussions relating to whether knowledge may be considered a quality of individuals or organisations. In essence we are arguing for a view where knowledge is a quality of the individual, but may be observed to be a characteristic of an organisation by an observer.

This description of autopoietic theory should only be considered as cursory and is provided in order to allow for discussions in relation to the difference between knowledge, information and data in the next section.

KNOWLEDGE, MEANING & INFORMATION: IMPLICATIONS OF AUTOPOIETIC THEORY

To understand the implications of autopoietic theory with reference to the differences between knowledge and information, the key issue that needs to be discussed is the nature of meaning, or meaning attribution. Some of the authors, whose work was described previously, give detailed discussions of these relationships, and it is through these discussions that the shortcomings of current approaches may be most clearly seen. Of the management theorists cited thus far, Nonaka and Takeuchi (1995) discuss the distinction between knowledge, meaning and information in the most detail. They are quite explicit regarding their assumptions on the difference between knowledge and information, acknowledging the fact that many writers use the terms knowledge and information interchangeably. In so doing they make three observations with regard to the difference between these notions;

1. *Knowledge, unlike information, is about beliefs and commitment... it is a function of a particular stance, perspective, or intention.*
2. *Knowledge, unlike information, is about action. It is always knowledge 'to some end'.*
3. *Knowledge, like information, is about meaning. It is context specific and relational.*

(Nonaka and Takeuchi, 1995:58)

The first observation, assuming that they are referring to tacit knowledge, is consistent with Polanyi's original conceptualisation and points out the valueless (in terms of beliefs) nature of information. The second observation with regard to knowledge being 'about action' is significant as it implies a more embodied concept of knowledge, relating it to the process of living. The third observation Nonaka and Takeuchi make, that information and knowledge both involve meaning, is problematic, for reasons of conceptual coherence. Following Shannon and Weaver's (1959) theory of communication, meaning is created by the individual receiving the information and is not a quality of the information itself. Nonaka and Takeuchi (1995), however, recognise two dimensions in their conceptualisation of information. The first is the 'syntactic' or volume of, as described by Shannon and Weaver (1959) and the second is the 'semantic', or meaning of the information. Nonaka and Takeuchi argue that the semantic dimension of information is very important to the process of knowledge creation due to its focus on the conveyance of meaning. They suggest that to limit the notion of information to the quantitative, "...will lead to a disproportionate emphasis on the role of information processing, which is insensitive to the creation of new meaning out of the chaotic, equivocal sea of information" (1995:58). They go on to say that, "...information

is a flow of messages and that knowledge is created by that very flow of information, anchored in the beliefs and commitment of the holder" (*ibid*).

Viewed from an autopoietic perspective, there are difficulties with this particular conceptualisation of information and meaning. Notions such as useful, timely or meaningful are not innate characteristics of the information itself but rather observations that the practitioner makes about the information. These observations are a function of the practitioner or observer's own particular cognitive structure and its relationship with the environment.

The conventional view is that information is somehow lying out there to be picked up by the brain. However, such a piece of information is a quantity, name or short statement that we have abstracted from a whole network of relationships, a context, in which it is embedded and which gives it meaning...we can abstract from the context, associate it with the meaning inherent in that context and call it information. We are so used to these abstractions that we tend to believe that meaning resides in the information rather than in the context from which it has been abstracted.

(Capra, 1997:265)

If this position is accepted, then arguably the notions of tacit knowledge, explicit knowledge, meaning and information, as described in the work of Polanyi, Nonaka and Takeuchi confuse the process of meaning attribution described above with the concepts to which meaning is attributed.

Towards an Autopoietic Perspective on Knowledge

An autopoietic view of knowledge is very different to the views put forward so far. Maturana and Varela describe knowledge or the process-of-knowing in a number of different ways. The recognition that the way in which individuals know is intimately connected with the structure-determined way that they experience, leads to the following description of knowledge, "This circularity, this connection between action and experience, this inseparability between a particular way of being and how the world appears to us, tells us that every act of knowing brings forth a world ... [as such].... all doing is knowing, and all knowing is doing" (Maturana and Varela, 1992:26).

This particular epistemological stance, is referred to, by the authors, as objectivity-in-parentheses. It is important to note that the process-of-knowing for Maturana and Varela brings forth 'a' world not 'the' world. Reality is an embodied notion that cannot be separated from the living process of the individual. Within Maturana and Varela's conceptualisation, the notions of doing, being and knowing are all bound into the single notion of knowledge and all of these notions are subject to structure-determined processes of change. As a consequence of these relationships, knowledge may be considered as the range of potential behaviours that an individual may take part in at any particular point in time. As the nervous system's structure changes, so too will the potential range of behaviours that its structural-determinancy makes possible. This is due to the plasticity of the nervous system (Maturana and Varela, 1992).

If this perspective were to be translated into the language of Polanyi's (1967) theory, it would be referring to both the individual's tacit and explicit knowledge as a single notion. Sveiby's (1997) definition of knowledge as a capacity to act is not inconsistent with the framework. As Sveiby observes "Ones capacity to act is created continuously by a process-of-knowing" (Sveiby, 1997:37). The process by which the individual's capacity changes over time is linked implicitly to the ordering effects of information. Viewed from an autopoietic perspective, information is an element of the environment, that is both perturbed by and a perturber of, the individual. Information is not an element of the individual's structure, but rather a product of it. An individual's observed behaviours, it could be said, trigger structural changes that may affect the behaviours of others in some way. Behaviours, therefore, become information when observed.

The notion of meaning from the above perspective is implicitly linked to the notion of context as alluded to above. Whitaker (1996) examines the notion of 'context' from a number of

different perspectives. From an information-processing perspective he suggests that, "...'context' denotes background or 'meta-level' information which constrains or determines the interpretation of other data. To serve a contextualizing function, such information must be present to or known by the observer/ interpreter" (Whitaker, 1996:399). This perspective is limited, however, due to the way in which it defines the notion of 'context', the implication is that the notion that guides the process of interpretation of new data is itself treated as a set of ordered data. As such, the information-processing perspective falls in on itself. Interestingly, Whitaker adopts an autopoietic perspective in his search for an epistemological escape from the problem. From an autopoietic perspective, 'context' becomes the process through which the individual relates to their environment, rather than a static object. Whitaker, (1992) describes this process as 'contexture' – an interweaving of referentiality and signification. The 'context' is not a function of the environment or the individual but the continuous process of structural coupling that occurs between the two, a position supported in the work of Uribe. "Observers know and create their environment through interactions with it. This interaction involves an explicit or implicit prediction about the environment" (Uribe, 1981:51).

Accepting the above sets of relationships, the notion of context is observer dependent. Although this may appear to place autopoiesis with other contextually relativistic theories, it differs because of the way in which the notion of context is used. Contextual relativism generally places the notion of context outside the observer as an environmental notion, rather than as a function of the observer/ environment as a unity. The implication of the autopoietic perspective is that it is not useful to consider two individuals as being in the same 'context', even though for example they may be in the same room. The room is the environment; the context is the process by which each individual relates to it. As such action also forms an integral dimension of the context. "The observer sees as behaviour, or conduct the changing relations and interactions of the organism with its environment, which appear to him or her to be determined by sequences of changes of state of its nervous system"(Maturana, 1978:41). Knowledge, for Maturana and Varela, is therefore as contextually dependent as it is observer dependent.

This view has significant implications, not only for the way in which we define knowledge, information and data, but also for the way in which we conceptualise KMS. Firstly, knowledge is not an object that may be captured, packaged, processed and distributed. It is an embodied notion that implies a KMS by definition cannot possess or process knowledge. The best we can aim for is that the KMS may support actors' processes of knowing and acting. It becomes an additional medium through which interlocking behaviours can develop. This opens a range of issues in terms of understanding the ways in which structural coupling between actors emerges and the subsequent emergence of consensual domains, through which context is derived.

Knowledge Sharing and Consensual Domains

Within autopoietic theory, the notion of context is fundamental to how knowledge is shared. We would argue that the idea of knowledge sharing is implicitly connected with Maturana and Varela's notion of a consensual domain. "...The domain of interactions specified through... ontogenic structural coupling appears as a network of sequences of mutually triggering interlocked conducts that is indistinguishable from what [would be called] a consensual domain" (Maturana, 1978:47). In the same way the environment does not determine that context singularly, a consensual domain is defined not by the individuals or organisms under observation, but rather the sets of interlocking conducts or observed behaviours. Interlocking behaviours occur as a result of the process of structural coupling. Over time, the ontogeny of interactions between the two or more individuals (organisms) produces congruencies in their respective structures. These congruencies produce sets of behaviours that are mutually triggering for the structurally coupled individuals.

Consensual domains (or the sets of interlocking behaviours) operate essentially as closed systems i.e. they are self-organising. At the same time the consensual domain is open in terms of the individuals that produce the behaviour, therefore others can replace the component organisms so long as their structure is congruent with that of the already coupled organisms. It should be noted that a consensual domain, as the term is being used here,

does not denote a domain of consensus or agreement. It refers to a set of interlocking behaviours emerging from the process of structural coupling, such a set of behaviours could be described as coordinated behaviour. The development of a consensual domain has the effect that the people involved in a particular activity are experiencing a congruity of context. The logical conclusion therefore is that knowledge cannot be 'transferred' in the information processing sense of moving an object. Rather, knowledge can be shared through the development of consensual domains and the consequent production of congruencies between the respective contexts of individuals.

Other organisation theorists have discussed similar concepts in their descriptions of organisations and the way in which people develop shared understanding and coordinate their actions (see Weick and Roberts, 1993; Weick, 1993; de Geus, 1997). Weick and Roberts (1993), for instance, discuss the notion of collective mind that develops through heedful interrelating among members of a group. Collective mind is understood here not as residing in individuals but rather between individuals. A similar idea is expressed by the notion of consensual domains as the sets of mutually triggering interlocked behaviours of structurally coupled individuals, which in turn produce congruencies between the contexts of individuals. Although significant detail differences exist between the concepts of collective mind and consensual domains (as developed within autopoietic theory), the commonalities inherent in these concepts provide the basis for a significant new direction in KM research.

CONCLUSION

KM as a field is difficult to conceptualise for a number of reasons, as described above. As such one of the greatest challenges for an organisation in terms of developing KM strategy, is the development of a consistent and coherent framework for understanding the nature of knowledge in organisations and the implications that this has for the processes by which it is managed. As described in this paper the tendency to confuse the concepts of knowledge, information and meaning make it very difficult to develop a workable process. In this paper, the characteristics of these notions have been clearly separated, through an examination of autopoietic theory, in order to address this problem. The resulting conceptualisation provides a framework where information carries no meaning in itself, meaning is generated as an abstraction from the context. The context is the process by which the individual relates to their environment (physical and non-physical). Knowledge is the embodied process of doing, knowing and being. Simplified, it may be defined in the same way as Sveiby (1997) has done, as an individual's capacity to act.

The idea of knowledge transfer, due to the words used, promotes a conceptualisation of knowledge as an object. This particular perspective has limitations, however, due to the information processing focus that emerges. Given the autopoietic perspective adopted in this paper it is more appropriate to conceptualise the knowledge sharing process as the (partial) recreation of one's knowledge in another individual. The process by which this takes place requires a number of similar experiences on the part of the individuals who are supposed to be sharing their knowledge. This allows the relational process of contexture (Whitaker, 1996) to be mutually developed by those individuals involved, over time producing a consensual domain.

There are many open questions, however. While the theoretical basis for an autopoietic view is presented here, considerable work remains to be done in terms of translating the concepts of structural coupling and consensual domains into practical solutions for the workplace. While these questions are of general interest for understanding organisations, they are of particular interest to IS. Namely, in IS we would be interested to explore the actual or potential role of IS (or IT) in these processes in practice. Such an understanding would help us develop and maintain KMS that deserve their name.

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