Knowledge Mapping as Sensemaking in Organisations

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Abstract

In this paper we examine processes of knowledge management in organisations from a sensemaking perspective. By drawing on theoretical and empirical studies of knowledge creation and sharing as part of sensemaking activities, we analyse the needs and requirements for knowledge representation and technology to support social agents undertaking these activities. Following this analysis we propose an approach to represent agents' understanding in a particular domain of work in the form of mind maps, illustrated by an example. Furthermore, we describe an IT-based system designed to experiment with knowledge mapping and its use to assist agents in sensemaking and knowledge sharing processes.

Keywords

Organisational sensemaking, Knowledge representation, Knowledge utilization, Cognitive mapping, IT-based knowledge representation

INTRODUCTION

Knowledge is an assumed resource in all organisational activities. Some skills, competencies, expertise and experiences are required to conduct any activity. Yet the specific knowledge necessary to perform a task or a problem solving activity is often not readily available in an organisation. Although an employee may actually have the required expertise, those who need it may not know this. On the other hand, special expertise may be accumulated in several departments (eg. sales, marketing, maintenance, planning, product development) but the company may not be able to integrate and effectively deploy these rich knowledge sources within a common strategic planning process. While a variety of Information Technology (IT) applications have been implemented to deal with storing and retrieving knowledge in organisations, most of them in fact deal with data and information (Nissen et al., 2000; Ruggles, 1997). There is a rising awareness that acquisition, sharing, storing, finding and deploying knowledge, often called *knowledge management*, belong to a problem domain and a conceptual realm far beyond data and information management. Hence different approaches, methods, and technologies are needed to deal with them.

As a profoundly human phenomenon, knowledge differs from data and information. Data, as a structured record of an event or transaction – often captured automatically eg. at a point of sale – have no inherent meaning. They have to be interpreted, ie. "endowed with relevance and purpose", to become meaningful information to the user (Drucker, 1989, p.72). To become information, data need to be contextualised, classified, selected, processed, aggregated and presented in an understandable form (Davenport and Prusak, 1998, p. 4). A distinct feature of knowledge is that it originates in human minds and that it can be expressed and shared among

human beings as long as it makes sense for them. While data and information processing can be fully automated and computerised, knowledge management is a social process that inherently involves human agents.

Being inherently a human and social phenomenon, knowledge management cannot be mechanised and automated. However, in their processes of acquiring, expressing, sharing and using knowledge, human agents can be *assisted* and *supported* by IT-based systems. Recent research shows that so-called Knowledge Management Systems "designed specifically to facilitate the sharing and integration of knowledge" are just beginning to appear in organisations, that the interest for this kind of systems is very high across a variety of industries around the world, and that their technological foundations are varied (Alavi, 1999, p1). As a result there is very little empirical research and field data to guide the design and implementation of Knowledge Management Systems and to provide evidence regarding their potential benefits (eg. Barlett, 1996; Prusak 1996; Alavi, 1997, 1999; Watts, Thomas and Henderson, 1997; Choo, 1998; Martiny, 1998). Similarly, there is little understanding of the role of Knowledge Management Systems in organisations and the ways they can assist and support social agents.

The research presented in this paper is focused on social processes of knowledge management from a sensemaking perspective of organisations (Weick, 1995; Boland et al., 1994; Wiley, 1994; Starbuck and Milliken, 1988). Sensemaking involves processes of perceiving, believing, interpreting, explaining, predicting, and acting both individually and collectively in a given organisational setting. Weick emphasis that "sensemaking is grounded in both individual and social activity" (1995, p. 6) and questions whether the two are even separable. When people put pieces of information into a framework, this enables them to make sense of events and their environments (Starbuck and Milliken, 1988). From their study of interpersonal transaction processes Ring and Rands (1989) suggest that sensemaking is "a process in which individuals develop cognitive maps of their environment" (p. 342). By studying sensemaking processes in organisations we can understand better how individuals perceive and reflect upon their work processes and events, and how they create shared meanings and intersubjective understanding through social interaction. Furthermore, we can explore how they create collective knowledge and how this knowledge is legitimated and deployed as organisational knowledge.

By drawing on the investigations of sensemaking in different kinds of organisational processes (Weick and Roberts, 1993; Boland et al., 1994; Cecez-Kecmanovic et al., 1999; Kay and Cecez-Kecmanovic, 2000), in this paper we examine knowledge mapping as an approach and a method to support sensemaking and ultimately knowledge management. More specifically, we first identify the needs of social agents to (partially) map and share their knowledge, to create collective knowledge, and to coordinate their actions. Second, we propose an approach to represent an agent's understanding in a particular knowledge domain in the form of *knowledge maps* and illustrate their use by an example. Third, we describe an IT-based system (*Pythia*) that is being developed to experiment with knowledge mapping and to explore opportunities to assist agents in their sensemaking and knowledge sharing processes. The paper concludes with a brief review of research questions regarding the ownership and privacy of personal knowledge maps, inter-linkages among the maps, maintenance of collective maps, etc.

ORGANISATIONS AS SENSEMAKING ACTIVITIES

The needs for and a conceptualisation of technological support for processes such as creation, sharing and deployment of knowledge in organisational contexts will be identified within a

sensemaking paradigm of organisations. While there is no a coherent theory of organization that is characteristic of the sensemaking paradigm, "there are ways to talk about organization that allow for sensemaking to be a central activity in the construction of both the organization and the environment it confronts" (Weick, 1995, p. 69). Following Wiley's (1988, 1994) distinction of four semiotic levels (that is, *self, interaction, social organisation,* and *culture*) we identify respective sensemaking levels characterised by meaning creation, nature and ownership of knowledge. Furthermore, we identify the needs for technological support at these levels.

Organisations can be seen at four levels of sensemaking:

1. The **level of an individual** (self, agent, subject) who has thoughts, beliefs, feelings, experiences, intentions, etc. An individual makes sense of his/her work environment, tasks, problems, work practices, organisational policies, decisions, and the like, based on his or her prior experiences, education and knowledge. At the individual level "meaning is within the self" (Wiley, 1994, p. 154) and knowledge is individually owned.

2. The **level of social interaction** involves individuals (agents) in conversations who interpret events and situations intersubjectively and create shared meanings. By interacting within and without groups (formal or informal) individuals constantly create and recreate intersubjective meanings and collective knowledge. It is important to note that at his level "the meaning is not within but between and among selves" (Wiley, 1994, p. 154). In other words, collective knowledge is *in patterns of interactions or connections*, and not in a sum of individuals' knowledge. This can be linked to the concept of *collective mind* as heedful interrelating (Weick and Roberts, 1993; Ryle, 1949). While knowledge always resides in individuals, collective knowledge is distinct from individual knowledge as it inheres in the patterns of interrelating activities and practices. Consequently, individuals feel collective ownership of it.

3. The **level of social structure** emerges from social interaction characterised by "a shift from intersubjectivity to generic subjectivity" (Weick, 1995, p. 71). Continuously created in social interaction intersubjective meanings are synthesised in a *generic* meaning, transferable to other members that did not participate in its creation. At this level "concrete human beings, subjects, are no longer present. Selves are left behind at the interactive level. Social structure implies a generic self, an interchangeable part—as filler of roles and follower of rules—but not concrete, individualized selves" (Wiley, 1988, p. 258). Social structure reveals itself through roles and norms, administrative and control systems, decision-making processes, policies, that is, legitimised organisational knowledge.

4. The **level of culture** denotes a symbolic reality, conceptualised as an abstract idealised framework derived from prior interaction and common experience of organisational members, which is by its nature *extrasubjective.* "Culture is composed of pure meanings, divorced from the individuals who, in any concrete meaningful act, are required to think or feel these meanings" (Wiley, 1994, p. 158). Organisation culture is expressed in language, symbols, metaphors, and stories that affect meanings at other levels.

These four levels of sensemaking reflect different generalisations of social reality, implicating different degrees of knowledge sharing and different processes of knowledge maintenance and creation. An individual creates and maintains his/her image of organisation and his/her domain of work and action. By interacting with others the individual 'updates' this image, interprets a new situation and takes actions. In doing so, the individual engages in creating shared understanding of a situation with others and thereby participates in an ongoing process of (re)creating collective knowledge. Key to this process of developing mutual understanding and creating collective knowledge is the ability of individuals to establish heedful interrelations and to express their views, interpretations and positions in a mutually comprehensible form

(Weick and Roberts, 1993; Ryle, 1949). We identify here an opportunity for an IT-based representation that would assist individuals to express their understanding of a problem situation and enable them to engage in meaningful and heedful interaction with others so as to improve mutual understanding and coordinate their actions (Table 1). Moreover, such an IT-based representation may serve as a way of building a shared representation, and developing representation of collective knowledge over time.

By exploring other levels of sensemaking we can derive additional requirements for IT-based representations. The dynamics between the social interaction level and the level of social structure is particularly interesting and critical. For instance, the ways individuals interact and take actions are determined by patterns of communication, organisational routines, decision-making processes and control mechanisms as defined by social structure. On the other hand, individuals in interaction continuously create and innovate intersubjective meanings which cause changes of those patterns, routines, processes, and mechanisms. While forms of generic subjectivity tend to order and control activities and behaviour, human interaction as a permanent source of creativity and innovation tends to challenge these forms and control mechanisms. The tension between intersubjectivity (involving collectively shared knowledge by different groups or teams) and generic subjectivity (involving established organisational knowledge) is one of the essential defining processes of organisation (Weick, 1995).

Levels of sensemaking	The nature of knowledge	Requirements for IT support
An individual	Meanings are within the self and knowledge is individually owned.	• Maintenance of individual representations of relevant knowledge • Expressing individual understanding of a situation while conducting activities and taking actions
Social interaction	Meanings are intersubjective, between and among selves; Collective knowledge is in patterns of interactions, interrelating activities and practices; Individuals feel collective ownership of it.	• Creating shared understanding and representation of a situation leading to coordinated actions by several actors • Development and maintenance of collective knowledge over time • Individual contribution and sharing in the (re)creation of collective knowledge
Social structure	Social structure involves generic meanings and legitimised organisational knowledge. It includes values, norms and rules, administrative and control systems, roles, decision-making processes, policies, etc.	• Explicit representation of organisational knowledge in a form available to organisational members • Representation of rules and processes by which knowledge is recognised and legitimised as organisational knowledge • Establishment of processes for challenging accepted assumptions and claims

Table 1: The nature of knowledge and IT support at different levels of sensemaking

Here we identify the need for representing organisational knowledge in such a way that it is readily available in an explicit form to all members of an organisation. In addition, rules and processes by which this body of knowledge is legitimised and can thus be challenged and changed should also be explicit and readily available (see Table 1). This, however, does not

mean that it necessarily assumes correspondence between organisational knowledge and collectively shared knowledge. Nevertheless, one can hypothesise that the more social structure is open to reflection and criticism, the richer and more appropriate organisational knowledge will become. This has significant implications on the success of organisations and their strategies and policies. Oversimplified beliefs and stereotypes are reported to be a major contributor to organisational decline and failure in both the private and the public sector (Starbuck and Milliken, 1988; Janis, 1989, Boland et al., 1993).

All the above processes of sensemaking are embedded in and constrained by organisational culture as sedimented common experiences. The culture in turn is recreated through social interaction and innovation inherent in building common understanding, as well as through processes of recreating generic subjectivity and social structure. While we acknowledge the importance of culture in all aspects of organisational sensemaking, in this paper we limit our examination to the other three levels.

The summary of requirements for IT-based representation of knowledge at the three levels of sensemaking is presented in Table 1. While the broad requirements for IT support of actors identified in this table are subject to further investigation within a large research project underway[1], in this paper we focus our attention on issues of knowledge representation and sharing.

REPRESENTING KNOWLEDGE TO ASSIST SENSEMAKING

One of the basic requirements for IT support for sensemaking at all three levels in Table 1 is representation of knowledge in such a way that it can be shared, maintained, questioned, created and re-created throughout an organisation. Basically actors need to present and share their concepts, ideas, views, beliefs, experiences, interpretations, or in one word, elements of what they know. The purpose of presenting them in a computer readable form is manyfold.

First, an individual would ideally want to have immediate access to all elements of knowledge relevant for a task/process at hand (eg. delivery of a subject in a university, booking a room). Furthermore, in the course of acting and performing his or her duties the individual would need to add new facts, interpretations or views. This can be achieved to the extent to which this individual can explicate his/her understanding of the task/process and specify relevant elements of knowledge. Presented in a computer readable form these elements would then be linked to knowledge sources elsewhere in the organisation (other actors knowledge repository, databases, documents, Web pages, etc.). An experienced person, socialised in the organisation culture, would use words and would name things in a way shared by many people in the organisation. Therefore, individual knowledge representation of such an experienced person will be easily interconnected with other representations and organisational knowledge sources. Consequently, it will be well integrated into organisational knowledge. However, knowledge representation by a less experienced individual would initially be more idiosyncratic and not easily interconnected with other sources of knowledge. This suggests that the purpose of knowledge representation is also to assist individuals in their learning and socialisation in the organisational context.

Second, a group of people responsible for an activity (eg. delivery and management of an MBA course, resource allocation for different courses) need to represent, create and re-create their collectively shared understanding of the activity in order to coordinate their actions and perform this activity. In the course of working together, members of such a group develop shared understanding of the relevant issues spontaneously, without technology, as part of their

[1]An Australian Research Council (ARC) SPIRT grant "Knowledge Management Enabling Environment-A New Concept, Technology and Methodology" (2000-2002).

social interaction processes. When they use particular words and concepts, they refer to an unproblematic background knowledge, assuming mutually agreed meanings. However, if members rely on their memory alone they may experience breakdowns in the conduct of their activity due to misunderstandings and different perceptions and views of the problem, they were unaware of beforehand. Moreover, as the group develops and changes its membership, it may have problems maintaining a consistent body of their collective knowledge especially as it is related to other activities and other groups in the organisation. This is why an IT based representation of collective knowledge is needed. By representing their shared understanding explicitly, in a computerised form members of the group would be able a) to recognise discrepancies with their individual understanding of an activity or a situation at hand, b) to identify gaps in their collective knowledge, and c) to search for addition knowledge from other computerised sources (including knowledge representation by other individuals and groups). In other words, the IT based representation of their shared understanding and collective knowledge would assist their social interaction and sensemaking processes.

Third, there is the need to represent knowledge in a computerised form at the organisation structure level, which is perhaps best understood. In fact, in the knowledge management literature knowledge representation is usually concerned exclusively with organisational knowledge (Alavi, 1999; Davenport and Prusak, 1998). In contrast to this approach we recognise organisational knowledge as a type of knowledge (determined by sensemaking at organisation structure level) shared by all members of an organisation and connected to knowledge representations by groups and individuals. Organisation knowledge is different from the other two as it needs to be legitimated and its creation is usually subject to a due process. For instance, norms and rules governing an MBA course, the role of an MBA director and administrator, subject outlines, and registration of students, are all elements of organisational knowledge of a Graduate Business School. To introduce or change eg. rules of conduct, specification of tasks and responsibilities associated with roles (MBA director and administrator), etc., a proper procedure has to be followed, which itself is determined by legislation. Assuming that some of these elements are already available in traditional information systems (such as student records database) or in document management systems (legislation, subject outlines) or on the Web site (description of the MBA program), still a considerable part of organisational knowledge relevant for managing and organising the MBA is neither explicit nor readily available. Therefore, to support sensemaking at the organisation structure level all relevant elements of knowledge have to be identified, mutually interconnected and integrated with existing knowledge or information sources. Such representation of organisational knowledge would inevitably involve a particular interpretation of legislation, values, rules etc., which of course cannot be arbitrary. For that reason the way organisational knowledge is represented and maintained has to be regulated, thus becoming itself a part of the social structure.

From the above discussion we may conclude that there are valid and justified reasons to represent knowledge in a computerised form to assist and support sensemaking processes at different levels. We have to note here that the purpose of knowledge representation is not to automate knowledge processing and reasoning (such as in AI systems) or to 'replicate' knowledge of individuals or groups 'as authentically as possible' in Knowledge Management Systems (Newbern and Dansereau, 1995). We, instead, propose representations of knowledge as *traces* of individual and collective knowledge that serve as *maps* or *guides* of complex structures of knowledge in a social context. The key issue here is that such maps make sense to the people involved, linking up with their deeper understanding and tacit knowledge. As such knowledge representation in a specific work domain is just a tip of an iceberg of individual and collective knowledge.

Knowledge representation as proposed here can be seen as a conceptual layer between users (individuals and groups) and computerized sources of data and information. Such a conceptual layer, on one hand, represents traces of human (individual and collective) knowledge as knowledge maps and, on the other, links these maps to databases, document bases and Web-based repositories of data and information. Given the complexity and uncertainty of human knowledge, such knowledge maps would necessarily reflect some of this complexity and uncertainty. Exploration of the desired and technically feasible forms of knowledge maps is underway. Some preliminary results are presented in the next section.

KNOWLEDGE MAPS

A well known form of representing human knowledge is the *mind map* that includes graphical and textual forms of presentation of concepts, their relationships and characteristics (Buzan and Buzan 1990). Similar representations, called *knowledge maps*, defined as two-dimensional diagrams which convey multiple relationships between concepts using nodes, links, and spatial configuration, have been proposed elsewhere (see eg. Newbern and Dansereau, 1995). Given the specific purpose of knowledge representation suggested in this paper, we adopt here the basic idea of mind and knowledge maps but not the ways they have been previously interpreted and used.

By giving a name to a thing, a concept, a process, an idea, etc., and presenting it as a graphical symbol (with this name) on a map, the intention is to establish an association between this symbol (with the name) and personal knowledge about this thing, concept, process, or idea. If, for instance, an academic from a Graduate Business School is asked to present a Master of Business Administration (MBA) program as a concept in a knowledge map, he/she would associate (often tacitly) with it a number of beliefs, claims, experiences, rules or feelings. He/she may also, if asked, make explicit representation of some of these belief, claims, experience, etc. For instance, in the case of the MBA program, the academic may express his/her believes that a) the program is conducted by the MBA director, b) it involves a student enrolment and registration process, c) it is governed by some regulations and rules and that d) it consists of subjects, one of which he/she is teaching (Fig 1). For this subject he/she creates a subject outline. The knowledge map in Fig 1 represents traces of the academic's knowledge, or more precisely his/her particular view of relevant elements of the MBA program and how these elements are interconnected.

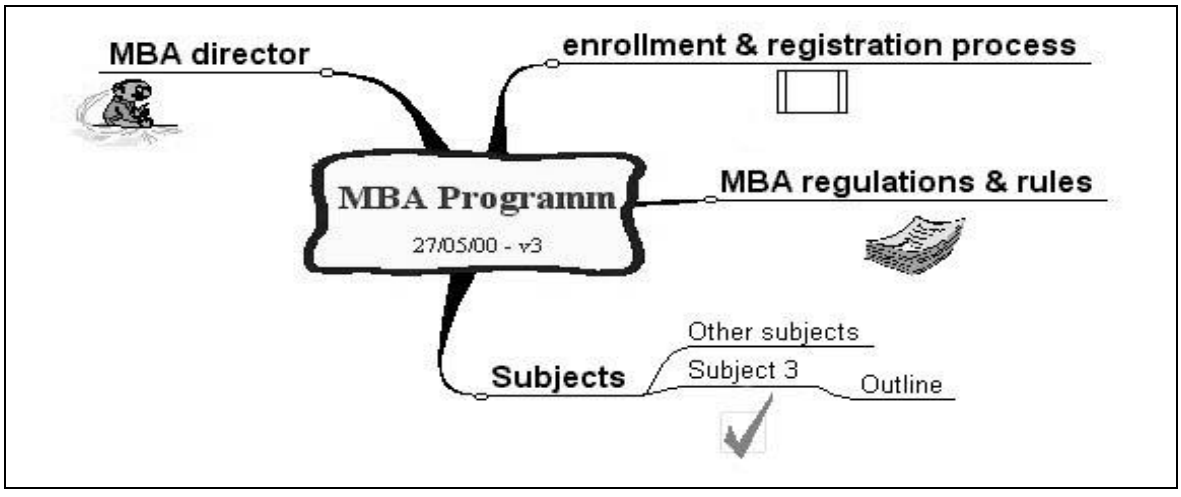

Figure 1: Lecturer's knowledge map

Furthermore, different individuals with different roles and tasks in an organisation would normally have different pictures of things, even in a similar domain of work. In our example of the MBA program, the relevant elements of knowledge for an administrative officer are: a) that the MBA program is approved by the Board of studies, b) that he/she gets information about students from the student database (updated in the registration process), c) that students submit their requests by forms (eg. for MBA project, leave of absence, internship, etc.), d) that the MBA director is responsible for running the program, and e) that there is a list of subjects, each taught by an academic and each linked to a subject outline (Figure 2). Each element on a map can be detailed further on another map, thus creating a stratified set of maps. In addition, all agents involved in an organisation activity (eg. the MBA) may have their own stratified set of knowledge maps.

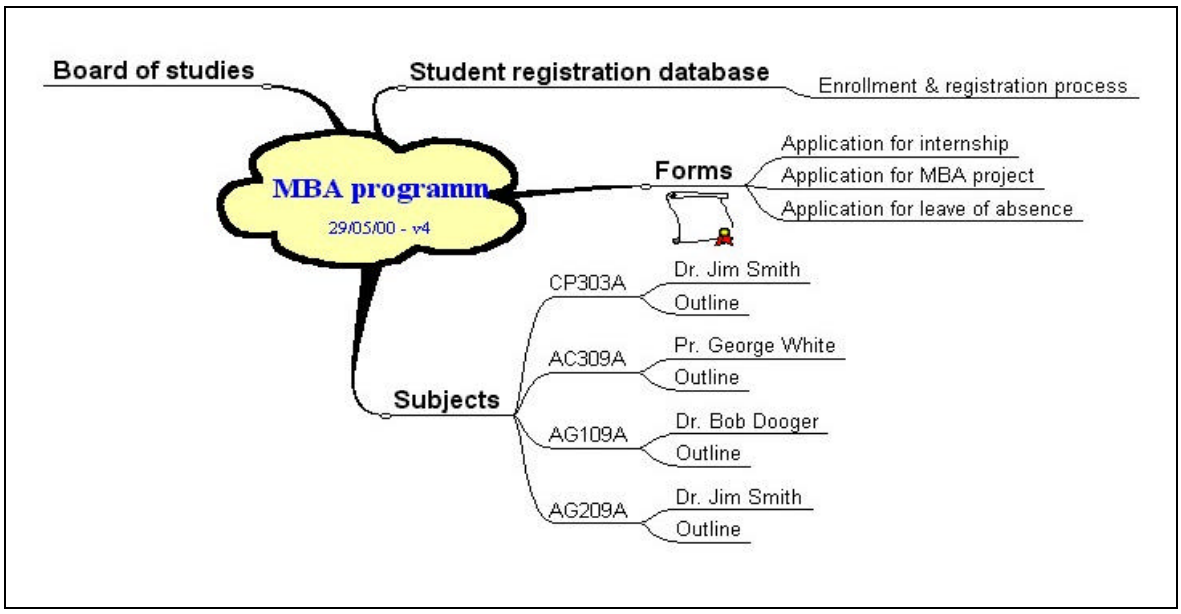

Figure 2: Administrator's knowledge map

Some differences among knowledge maps of different agents reflect their particular cognitive style, experiences and interpretations of reality, as well as their roles, tasks and responsibilities. Therefore one agent's map may have more or less detailed presentation of elements and their relationships compared to other agents' maps in the same domain of work. In addition, different agents will not necessarily use the same names for a particular phenomenon nor will they define the same boundary of the phenomenon. These differences are inherent to any social context across all three levels of sensemaking. The issue is to what extent the knowledge maps of different agents need to be mutually consistent.

While a certain degree of inconsistency among different agents' views is inevitable in any organisational context, significant discrepancies leading to misunderstanding, conflicting conclusions and decisions may cause problems (as they usually do when assumptions and beliefs are not explicitly addressed). Interestingly, comparison of knowledge maps may indicate inconsistencies otherwise not easily detectable before a conflicting situation. The more agents try to achieve consensus and coordinate their actions, the more they are motivated to develop an intersubjective interpretation of a situation and thus consolidate their views and knowledge maps. More research is required to describe and explain these processes.

Another purpose of using knowledge maps in a computerised form is to enable their interconnections: 1) between individual knowledge maps and collective knowledge maps created by groups, departments, teams, etc.; 2) between individual/collective knowledge maps

and the organisational knowledge map, and 3) between elements in knowledge maps and repositories of information (eg databases, document management systems and text files, intranet-based systems, groupware, etc.). As a conceptual layer mediating between human and social sensemaking and computerised sources of information and knowledge, the complex structure of knowledge maps is conceived as a key active component of an IT-based environment for knowledge management, allowing inter-subjective, cross-organisational sharing, creation and deployment of knowledge (more detailed presentation see Cecez-Kecmanovic, 2000).

CREATION OF KNOWLEDGE MAPS USING *PYTHIA*

An experimental system, named *Pythia*, is designed to provide technological tools for the development and implementation of knowledge maps in an organisation. The role of *Pythia* is to support individuals, groups and an organisation in representing their knowledge by creating, sharing, consolidating, and maintaining their knowledge maps. More specifically this role implies:

- assisting individuals to create their knowledge maps, and consolidate and maintain them as an integral part of their work processes
- providing support for checking consistency among different maps and for linking elements from one map with the other
- helping a group of people identify differences and gaps in their understanding, explore different views and produce a collective knowledge map
- assisting an organisation in presenting and maintaining its knowledge (organisation structure level)
- linking elements from specific knowledge maps with sources of knowledge and information elsewhere in the organisation.

While it is currently at an early design phase, *Pythia* allows experimental implementation and testing of the use and effects of knowledge maps. To illustrate its use, in this section we present briefly the first of its roles.

One role of *Pythia* is to assist knowledge externalisation process. Externalisation is defined as a transformation from tacit to explicit knowledge (Nonaka and Takeuchi, 1995). We use the term externalisation more specifically to denote the process by which an individual creates a knowledge map by realising the personal associations of knowledge elements in a specific context, within the individual's domain of work and area of expertise (Koulopoulos and Frappaolo 1999, p.200). *Pythia* assists an individual to create a graphical record of his/her understanding: by describing concepts, entities or any things he/she uses to do a job and complete the tasks, as nodes; and by drawing links between nodes that represent the perceived associations between these concepts/entities/ things. This is the initial externalisation process that results in a basic knowledge map (maps in Figures 1 and 2 represent examples of basic maps created independently by two individuals). Detailing its knowledge elements (both nodes and links) the basic map can be developed further, thereby increasing the map's complexity and its correspondence with the individual's knowledge. On the other hand, the externalisation process can proceed to dig out knowledge about processes and procedures (how things are done), that is, a dynamic aspect of entities' creation, change and functioning. Through the externalisation process, assisted by *Pythia*, the individual expresses part of his/her knowledge as a set of knowledge interrelated maps in a way that makes sense to him/her in the first place.

Through this process the individual also learns to use the modelling tools and to create, extend and recreate maps.

There is in principle no limitations as to what things can be mapped (in Figures 1 and 2 a few examples can be seen). However, our research suggests that the range of graphical forms to visually signal the meaning of a thing should be limited and consistent in any social context for several reasons. Firstly, by consistently using the same graphical form (such as a rectangle or an ellipse) for a particular type of concept, eg. one form to denote people, another to denote documents, yet another to denote processes, etc., makes it easier for an individual to associate meaning with a symbol when interpreting a map. Secondly, the use of a standard set of graphical forms collectively agreed by a group of users is necessary when maps are shared among them (otherwise mutual understanding would require 'translation' of symbols). Thirdly, graphical forms associated with particular meanings accepted by the whole organisation, and ideally incorporated in its symbols and culture, would help in the process of establishing links between different knowledge maps and building the organisational map. Ultimately it will help knowledge sharing across the organisation.

Once a knowledge map is created by the externalisation process, *Pythia* assists its owner to link some of the elements to various resources or repositories in the organisation. For instance, in Figure 1 "MBA regulations and rules" can be linked to a document file in the University document management system; "Subject 3 outline" may be linked to the academic's own text file (on his/her computer). The *Pythia* system is designed to enable linking elements in a knowledge map with a single database record, a document in the PDF format, a Web page described by its URL, a graphic file, or an application. The technical linking, however, has to be performed by an expert (eg. a knowledge designer).

Furthermore, the process continues in several directions, linking individuals' maps with collective knowledge maps and with an organisational knowledge map. Once an initial structure of maps is created, the process goes on, as the maps evolve reflecting changing perceptions and interpretations as well as individual and organisational learning.

CONCLUSION

In this paper we have proposed the sensemaking approach to organisations as a theoretical basis for research into knowledge management leading to the development of an IT-based system for knowledge representation and sharing. We explored the needs of human agents at different levels of sensemaking from which we derived the requirements for IT-based support. More specifically we explored the requirements for knowledge representation at different levels of sensemaking. Guided by these requirements, we designed the *Pythia* system to provide an IT-based environment to enhance an agent's ability to represent his/her knowledge in the form of knowledge maps, and to assist a group of agents to share their understanding, consolidate their views, and create and maintain their collective knowledge maps.

Several research questions arise from our study. Perhaps the most important one is whether individuals do in fact improve their sensemaking by externalising and sharing knowledge in the form of individual and collective knowledge maps, and what helps them (and what does not) in these processes. Another important question is: to what extent do they feel ownership of these maps and under what conditions will agents share their maps and engage in a consolidation process? These conditions, by the way, are largely determined by organisational culture, by norms, processes and policies at the social structure level, as well as by social interaction practices. Furthermore, a related question would be whether and how creation and maintenance of collective knowledge maps by a group of agents will affect their heedful

interrelating, cooperation, and coordination of their actions. Or are adverse effects, such as increased control and surveillance of individuals, also probable?

While the sensemaking theoretical framework provides foundation for our future investigation of these questions, the *Pythia* system provides practical means to conduct it. A series of experiments in real life situations is underway. These will lead, among other things, to further development of the *Pythia* system itself.

REFERENCES

Alavi, M. (1997) "KPMG Peat Marwick U.S.: One Giant Brain", Case 9-397-108, Harvard Business School. Boston, MA.

Alavi, M. (1999) Knowledge Management Systems: Issues, Challenges and Benefits, *Communications of the Association for Information Systems*, 1, Article 7, February, 1-29.

Barlett, C. (1996)" Mckinsey & Company: Managing Knowledge and Learning, Case 9-396-357, Harvard Business School, Boston, MA.

Boland, R., Tenkasi, R.V. and Te'eni, D. (1994) Designing Information Technology to Support Distributed Cognition, *Organization Science*, 5, 3, 456-475.

Buzan, T. and Buzan B. (1990) *The Mind Map Book*, BBC Books, London.

Janis, I.L. (1989) *Crucial Decisions*, The Free Press, New York.

Joulopoulos, M. T. and Frappaolo, C., (1999) *Smart Things to Know About Knowledge Management*, Capstone, Oxford.

Cecez-Kecmanovic, D., Moodie, D., Busuttil, A. and Plesman, F.,(1999a) Organisational Change Mediated by E-mail and Intranet – An Ethnographic Study, *Information Technology and People*, 12, 1, 9-26.

Cecez-Kecmanovic, D. (2000) Knowledge Management Enabling Environment, *IS-KOMO* Internal research publication #I-3, UWS, Australia.

Choo, C.W. (1998) *The Knowing Organisation – How Organisations Use Information to Construct Meaning, Create Knowledge, and Make Decisions*, Oxford University Press, New York.

Davenport, T. and Prusak, L. (1998) *Working Knowledge*, Harvard Business School Press, Boston, MA.

Drucker, P. (1989) The Post Business Knowledge Society Begins, *Industry Week*, April 17.

Kay, R. and Cecez-Kecmanovic, D. (2000) " When knowledge Becomes Information: A Case of Mistaken Identity", the International Conference on *Theoretical and Practical Aspects of Knowledge Management TAPKAM 2000*, London, 6-8 Sept.

Martiny, M. (1998) Knowledge Management in HP Consulting, *Organisational Dynamics*, 27, 2, 71-77.

Newbern, D. and Dansereau, F. D. (1995) "Knowledge Maps for Knowledge Management", in K. Wiig (ed), *Knowledge Management Methods: Practical Approaches to Managing Knowledge*, Schema Press, Arlington, Texas.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge Creating Company*, Oxford University Press, New York.

Prusak, L. (ed.) (1996) *Knowledge in Organisations*, Butterworth-Heinemann, Boston.

Starbuck, W.H. (1992) Learning by Knowledge-Intensive Firms, *Journal of Management Studies*, 29, 6, 713-740.

Starbuck, W.H. and Milliken, F.J. (1988) "Executives' Perceptual Filters: What They Notice and How They Make Sense", in D. Hambrick (ed.), *The Executive Effect: Concepts and Methods for Studying Top Managers*, JAI Press, Greenwich.

Ring, P.S. and Rands, G.P. (1989) "Sensemaking, Understanding, and Committing: Emergent Interpersonal Transaction Processes in the Evolution of 3M's Microgravity Research Program", in A.H. Van de Ven, H.L. Angle, and M.S. Poole (eds), *Research on the Management of Innovation: The Minnesota Studies*, Ballinger, New York, 337-366.

Ryle, G. (1949) *The Concept of Mind*, University of Chicago Press, Chicago.

Watts, S.A., Thomas, J.B. & Henderson, J.C. (1997) "Understanding 'Strategic Learning': Linking Organisational Learning, Sensemaking, and Knowledge Management", *Proceedings of the Academy of Management Meeting*, Boston, MA.

Wiley, N. (1988) The Micro-Macro Problem in Social Theory, *Sociological Theory*, 6, 254-261.

Wiley, N. (1994) *The Semiotic Self*, Polity Press, Cambridge.

Weick, K.E. (1995) *Sensemaking in Organizations*, Sage.

Weick, K.E. and Roberts, K.H. (1993) Collective Mind in Organisations: Heedful Interrelating on Flight Docks, *Administrative Science Quarterly*, 38, 357-381.

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