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Understanding the Nature of Knowledge for Building Effective Knowledge Management Systems: Bridging the gap between Cyber and Cognitive Space.

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Abstract

Much literature has been written in regards to Technology driven Knowledge Management, and whether it is even possible for non-human systems to manage a process that is essentially human in nature. The initial hype surrounding Knowledge Management Systems (KMS) has dissipated into a more jaded expectation of what those systems can – or more accurately, cannot – do. The purpose of this paper is examin and present a balanced account of how Knowledge Management can be facilitated by appropriate choices of Information Systems and the context and expectations of their implementation.

Keywords

Knowledge, Knowledge Transfer, Knowledge Management, Knowledge Processes, Knowledge Management Systems, XML, Ontogolies, Semantic Web,

1. INTRODUCTION

As Information Systems have proliferated in organisations, it has been a natural outcome to assume the increased "*potential of using modern information technologies (e.g., the Internet, intranets, browsers, data warehouses, data filters and software agents) to systematize, facilitate, and expedite firm-wide knowledge management*." [Alavi et al., 1999]

A Knowledge Management System (KMS) is a technology system that uses Information Technology to create, organise and disseminate knowledge throughout an organisation [Alavi et al., 1999]. At face value, it appears that such a task could be effectively managed by a purpose built system containing organisational information and processes. In reality however, many organisations have fallen into the same Productivity Paradox [Willcocks, 1999] associated with so many implementations of IT projects. The Systems have proved to be ineffectual at actually capturing Organisational Knowledge [Beckett et al., 2000].

Current research into Knowledge Management suggests a variety of reasons why computer driven Knowledge Management has failed to deliver, not the least of which is that organisations have failed to recognise:

(1) the nature of knowledge -
"*knowledge is not a structurally identifiable entity... value is realized only when it brings a meaning into a context*." [Bhatt, 2000]

(2) the culture of the organisation -
"*An organization… is an artefact of personal experience and social relations... Managing information at social level is not easy, however, because people-centred information is unstructured, emergent, and creative*." [Davenport, 1994]

and;

(3) how to effectively use technology to facilitate synergy within an organisation's structure -
"... one of the critical tasks of the management is to coordinate different packets of knowledge through information exchange and sharing." [Bhatt, 2001].

2. THE NATURE OF KNOWLEDGE:

2.1 What is Knowledge:

The plethora of definitions for Knowledge in the literature serves to only reiterate its complex nature, however, general consensus can be found on a number of issues.

Firstly; Knowledge is not Information. The need to distinguish the two concepts [Wilson, 2002] runs through almost all of the literature available on Knowledge Management.

Secondly, Knowledge is related to Information. Whether knowledge is perceived as "actioned" information [Maglitta, 1996] or simply information that has been given a conscious "meaning" [Bhatt, 2001], it is clear that there is a relationship between the two, and that the recursive nature [Bhatt, 2001] of that relationship includes the exchange of "data".

2.2 Data, Information & Knowledge:

Alavi suggests that.. "*information becomes knowledge once it is processed in the mind of an individual*" [Alavi et al., 1999], however if "Processing Information" was all that was required for Information to become Knowledge, then clearly computer systems would be much more successful at achieving Knowledge Management. Computers are particularly good at processing [Lueg, 2001], and even better at automating processes, but they seem particularly inept at Managing Knowledge. [Wang, 2002]

The key to understanding the deficiencies of implemented KMS's is in understanding the difference between data, information and knowledge.

> "*data is raw numbers and facts, information is processed data, and knowledge is 'information made actionable'* " [Maglitta, 1996]

2.3 The Complexity of Knowledge:

While Maglitta's definitions are somewhat simplistic, they go further than Alavi in that they attempt to demonstrate how information becomes knowledge when it is held in the mind, ready to be applied to new situations. The intelligent ability to take information and see how it relates to new situations is still out of the realm of even the most advanced computer systems… it remains an essentially human ability. Knowledge then, "*is fundamentally about people*" [Dougherty, 1999], "*embodied within an organisation*" [Rowley, 1999] because it is embedded within the organisation's people [Sveiby, 1997]. Of course, this then implies that knowledge is also utterly subjective [Alavi et al., 1999], and context dependant [Marakas, 1999], having been "*learnt through experience and practice*" [Bhatt, 2001]. So "*Knowledge is a living thing*" [Merlyn, 1998], idiosyncratic in nature and application.

Marakas pushes this concept still further, suggesting that individuals bring their own existent belief structures to newly acquired information. "*Knowledge is context dependent, since 'meanings' are interpreted in reference to a particular paradigm*" [Marakas, 1999]. This is a considerable leap in the concept of knowledge. It takes an existent life-force embedded in the head of an individual and suggests it is used to create new meaning from the data and information around that individual. In other words, existing knowledge is used to create new knowledge. And, the process is continual with ever increasing potential "*accumulated prior knowledge increases the ability to accrue more knowledge*" [Bhatt, 2000]

2.4 Knowledge & Technology:

By far the greatest criticism of Knowledge Management Systems is their purported inability to actually Manage Knowledge. Their evolution however has been made more problematic because most Intranets and other internal IS projects were not built with Knowledge Management in mind. [Davenport et al., 1998]. Technologies that "just happen" still have the potential of meeting business needs (in fact, their developmental nature may lend themselves to some projects). Davenport suggests however, that the complexity of Knowledge and Knowledge Management "*does not lend itself to prescriptive implementation methodologies*" [Davenport et al., 1998]. The problem is compounded when a technology solution becomes the focus of any project. This is particularly true in area like KM, as the processes involved are both strategic and inherently human, ie: cognitive, reflective, applicative.

Wilson concludes then, in the context of its complex and intangible qualities, that the concept of Knowledge Management is in fact, non-sensical. "*information may be managed, and information resources may be managed, but knowledge (i.e., what we know) can never be managed*". [Wilson, 2002] Although such a radical view is not widely shared, there are many researchers now suggesting it could be said of Knowledge

Management Systems. Beckett however, reminds us that the failure of KMS's is not so much a failure of technology, but a failure of strategy and process. "*…technology is simply a resource to enable the process to operate; if the process is well thought out then the supporting technology is more likely to be appropriate*" [Beckett et al., 2000]. In other words, Beckett – like Davenport – is suggesting that if a better understanding exists of both Knowledge and Knowledge Management strategies, goals and processes, then technology can be developed to meet those needs. Intranets, Knowledge Repositories, Databases and a myriad of other Computer tools have been technology driven rather than people driven for too long now. "*Despite its importance, IT is a means to an end, rather than the goal itself*" [Stoddart, 2001].

2.5 The Importance of Knowledge Management:

That Knowledge Management is important to an organisation is without question. Machlup described knowledge as "*a key organizational resource*" [Machlup, 1980], the successful managing of which will result in sustained long-term competitive advantage. [Bhatt, 2001] Alavi reiterates this point "*knowledge is the organizational asset that enables sustainable competitive advantage*" [Alavi et al., 1999], but reminds us that as valuable as knowledge is to each individual, it is "*of limited organizational value if it is not shared*" [Alavi et al., 1999].

The goal of Knowledge Management then, is to facilitate the creation, retention and transfer of knowledge throughout an organisation. A KMS is just one of a selection of tools available to the Knowledge Manager. The fundamental change required in any organisation that aims to develop and manage its knowledge is a strategic shift in organisational culture.

3. ORGANISATIONAL KNOWLEDGE:

> "*Knowledge management involves creating a new culture and mindset, which enables organisations to recognize their tangible and intangible resources and how they should be developed and managed*" [Stoddart, 2001]

3.1 Knowledge & Organisational Capital:

Historically, Organisational Capital was those physical assets that had associated tangible value. In today's Post Industrial, Knowledge Age [deGues, 1999] Intellectual Capital is recognised as having great value. McCampbell suggests that in this "*move from the industrial age to the technological age, intellectual property or knowledge impacts profitability*" [McCampbell et al,. 1999]. The managed development and exploitation of an organisation's knowledge assets with the view of meeting organisational objectives is the concern of Knowledge Management [Davenport et al., 1998].

3.2 Organisational Culture & Knowledge Sharing:

Central to the idea of Knowledge Management is an organisational culture that actively encourages and rewards the sharing of knowledge. "*Knowledge sharing… only works if the culture of the organisation promotes it*" [Curry, 2000]. This requires a high-level strategic approach that aims at changing corporate culture so that information and knowledge sharing become second nature.

"*The critical role for IT lies in its ability to support communication, collaboration, and those searching for knowledge and information*" [McCampbell et al,. 1999] but it cannot – of itself – manage knowledge. IT Systems can be used as an enablers of Information transfer, but the essential ingredient is still people, who interpret that information into their own knowledge [Bhatt, 2001] by linking it to their existing knowledge.

Detractors of Knowledge Management and Knowledge Management Systems state emphatically that Knowledge cannot be managed because it is a cognitive process. They also state that Information Systems are particularly weak as a tool of Knowledge Management because the system has to span a "*space that begins with the physical and ends with the cognitive*" [McCampbell et al,. 1999]. The difficulty with adhering to such a view is that all Information Systems work in this space between Cyber and Human reality. Secondly, knowledge has to become data or information again to start the process of transfer, regardless of the method used. The information then is transferred back into knowledge once the message is received. Methodology of storage and transfer should not be the primary focus of any Knowledge Management. A balanced approach would consider Knowledge Processes as the primary focus, and then select various methodologies to meet organisational needs.

4. KNOWLEDGE PROCESSES:

Demarest (1997) and Bhatt (2001) propose similar models for the processes involved in Knowledge Management. Understanding how these processes work is central to developing both an organisational culture

that will foster Knowledge sharing and selecting the right combination of social and systems management to support Knowledge Transfer.

Figure 1:
Demarest's model .. four phases of knowledge management

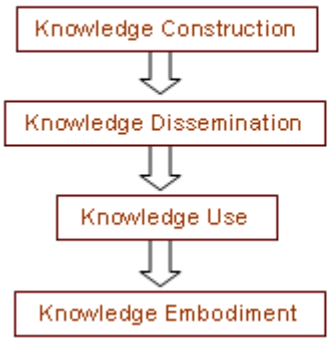
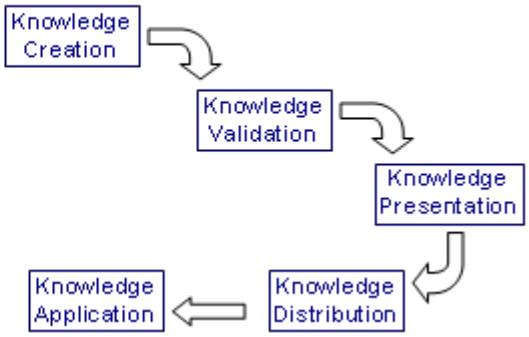


Figure 2:
Bhatt's Model .. Knowledge management process activities



Below is a diagram combining the processes of Knowledge Management proposed by both Demarest and Bhatt. Each phase is considered as part of whole cycle with explanations of how they relate to each other. The word Knowledge is replaced by "Information" when it is going through a process of transfer from one form to another. Finally, a description of the methods involved that allow the process to take place is proposed. ie: Knowledge Creation involves either an individual or group of people going through a cognitive process.

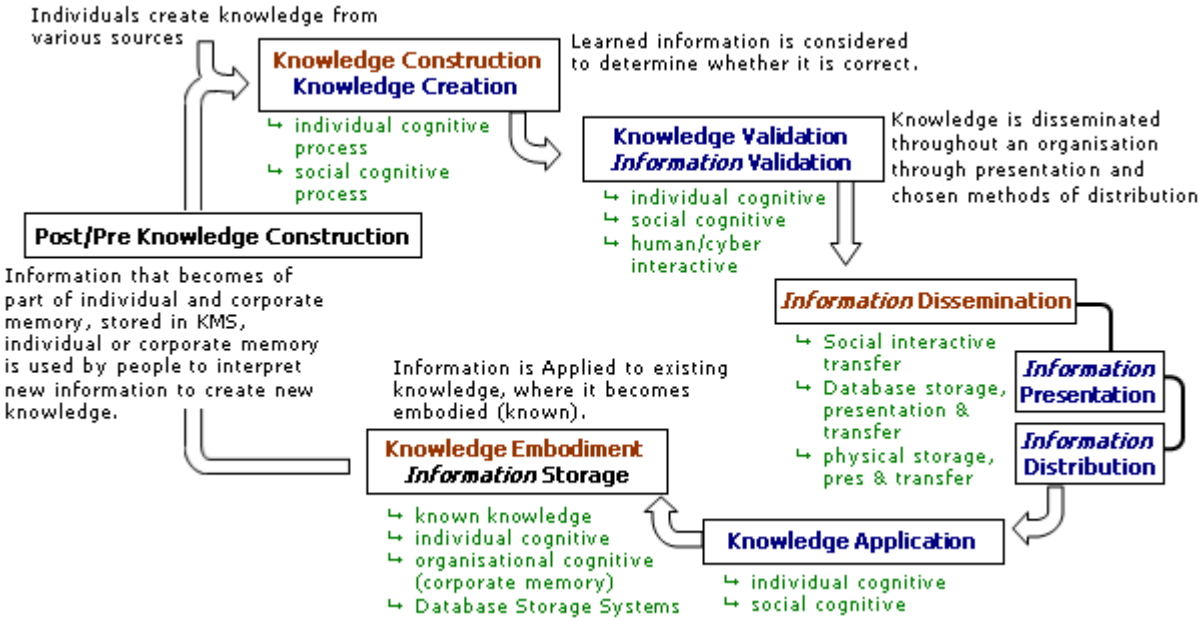


Figure 3: Knowledge Transfer Processes

The value of building a Process-Flow diagram such as the one above, is that it begins to reveal at which stages of Knowledge Transfer that knowledge becomes Information and visa versa. The advantage of this is two-fold. Firstly, it can prevent managers sinking billions of dollars into KMS's that will produce marginal results [Sveiby, 1997] and secondly helps managers determine the appropriate phases for Technology to be included, as well as the specific applications that can be used. For example, including technology at the Knowledge Construction stage may – at face value – appear inappropriate, however… if the knowledge construction is to be "interpretations of massive amounts of data" then technology applications are absolutely imperative in the pre-construction phase.

5. THE TECHNOLOGY OF KMS: choosing appropriate technologies to enhance Knowledge Management

Stoddart suggests that IT is an essential tool for organisational "*information flow and knowledge sharing*" [Stoddart, 2001].

While Computer Systems will always have their detractors, the fact remains the sheer capacity of information that can be stored and presented on a network of computers is staggering. Their strength of course, comes not only in their storage capacity, but in their processing power and ability to sift through that stored information. Information can be placed into clusters – providing a context, information can be searched according to keywords, and information can be ordered into hierarchies so that it can be browsed within specific contexts. Moreover, all of this can potentially occur continuously.

If this is the case, why have so many KMS implementations failed to deliver expected outcomes? Suggested arguments for KMS failures already discussed previously in this paper are only part of the reason. The greatest difficulty for any Information System still lies in its ability to span the gap between Cyber and Cognitive space. Since Knowledge is one of the more cognitive of human behaviours, Information Systems designed to manage an organisation's knowledge begin from an extraordinary disadvantage.

5.1 New Technologies

The key to developing effective KM Systems lies in choosing appropriate technologies for and during specific phases of knowledge processes (figure 3). The application of TCP/IP type protocols provides the backbone for information distribution across organisational networks, and – while information distribution is of itself not Knowledge Management – it is a key feature in Knowledge Management Processes. The question is whether Systems have the capacity to begin grouping together parts of the data placed in them into bodies of information that give context and meaning to other existent information? Moreover, do they have the capactity to group the patterns of data together to such an extent that previously unrelated data takes on new meaning?

5.2 XML

A major advance in the field of systems information exchange is Extensible Markup Language (XML). "*Extensible Markup Language (XML),.. promises to do for information what HTML has done for documents*" [Otto et al., 2001]. Simply explained, XML is a standardised formatting language that allows the transfer of information between applications. This is absolutely paramount to integration between different software, hardware and server environments. Given the massive IT related failures of the late 1990's because of expensive, ineffectual IT implementations, integration between different platforms and applications is now considered central to any current IT solution, including the implementation of a successful Information or Knowledge Management System. "*The thrust of sharing information across organizational boundaries is that the parties involved will mutually benefit from increasing their competence in creating or capturing, retaining, disseminating, and exploiting knowledge, i.e. knowledge management*" [Otto et al., 2001].

XML files are relatively small, text based files that – like HTML – use markup language to instruct applications how to interact with documents, or parts of documents. They can also instruct applications *Who* to display specific parts of documents to, or *How* and *When* to display other parts of documents. Thus the concept of the "document" as a stand-alone file of data becomes antiquated. XML scripts can extract and display parts of a document so that the data and combinations of data displayed on a user's work station may in fact exist at only the time the user opens the XML file. In other words, content becomes about packets of information, brought together to become meaningful for individual users of a system. This type of information/data processing is much closer to human thinking patterns than previous document-based information systems.

5.3 XML, System Synergy & The Semantic Web

Synergy is used to describe "the interaction of two or more agents or forces so that their combined effect is greater than the sum of individual effects" [Dictionary.com] and takes place wherever there are connections between individuals or groups of people. Those connections are more often than not social in nature, and are absolutely essential for the transfer of knowledge within an organisation. And here-in could be the reason why Information Systems so often fail to deliver effective methods to manage organisational knowledge, they have been unable to create a system synergy. XML is just one of the new technologies that have the potential to develop system synergy.

The concept of Synergetic connectivity between computers is referred to by Berners-Lee as The Semantic Web [Berners-Lee]. In the Semantic Web, the current Internet – a Document Distribution System using HTML – would become an Information Distribution System by adding such technologies as XML and RDF.

RDF is Resource Description Framework, and uses URI's (Universal Resource Indicators) to describe objects, subjects and verbs of a given document, in a way that computers can slice up parts of documents and associate meaning by contexturalising similar entities. Ontologies are used to further group and sub-group documents by describing the rules of engagement between these entities. Specific properties can be assigned to documents or

– more importantly – specific parts of documents using XML and RDF, and synergy is created as computers interact with each other creating new ways for users to define and use information.

There are few people more qualified to present the potential of XML, RDF, Ontologies and URI's than Tim Berners-Lee. It was around 13 years ago, while on holiday in Switzerland, that Berners-Lee first borrowed parts of the SGML being used by CERN to create HTML. Hypertext has become the backbone of document exchange on the Internet. XML now borrows other parts of SGML, a markup language designed to be formal, structure and extensible [Connolly].

It is the extensible nature of XML that makes it so valuable in the creation of information repositories. Where HTML became a specific set of <markup tags> informal in structure, XML has a strict structure but with the power to create any number of <tags>. The capacity then to create user group, subject or concept specific metadata is truly staggering. Information availability and exchange can be automated between users of computer and/or software systems. Where a document may have been too complex or had too much information for a simple database, XML could make relevant parts of the document available for the Workstation on which the database is stored. It could then also make more parts of the same document available for a more complex database on another Workstation. Different parts of one document could be served to any number of workstations or users, depending on the access assigned by the XML tags. Moreover, specific parts of multiple documents could be served to a user as one document. The possibilities are as endless as the imagination of the XML programmer or the needs of the organisation.

5.4 Reality Check:

The key of course, is meeting the needs of the organisation. The adoption of these new technologies is of little value to if it is done for its own sake. Organisations will continue to pour massive amounts of money into their IT Sink wells unless they address the fundamental goals of any Knowledge Management System they chose to develop.

6. CONCLUSION:

The goal of Knowledge Management is to facilitate the creation, retention and transfer of knowledge throughout an organisation. The purpose of this paper was to address how the technology of Knowledge Management Systems could be effectively adopted as a tool for this process.

The adoption of any new technology however, should always be done within the context of an organisational shift towards a culture that encourages knowledge acquisition, facilitates knowledge retention, promotes knowledge flow and rewards knowledge sharing. If workers are by nature hoarders of their individual knowledge, then even the most brilliant of IS implementations can only achieve limited success at managing organisational knowledge.

From a technical point of view, XML – combined with strong Metadata technology – offers the best opportunity so far to build Information Systems that are information and content driven, rather than document driven. Working with networks of information rather than networks of application driven documents provides a foundation for a system that far closer mimics human thinking than document storage. It is these types of technologies that will drive Knowledge Computing in the coming years.

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