Constructive decision environments for knowledge management

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Introduction

Taking the panel's title as a starting point, knowledge management does not need to justify its role in relation to transient fashionable interest areas, but it does need to distinguish itself from the opportunism and hype that accompanies any perceived "next big thing". As long as organisations make informed decisions using knowledge and experience, "knowledge management" will be needed, and this function traditionally has existed in various predecessor forms.

Surveying and rationalising the field seems overwhelming, when it is a leading edge area not only in information systems, but in decision support evolution, in virtual organisations, in economic, accounting and marketing fields, to name but a few. When politicians brandish the word "knowledge" in policy circles, in manifestos impacting on initiatives for global competitiveness and national infrastructure, and directly on education and training provision, they are identifying something of long term duration they see continuing as significant. In Australia, the National Office of the Information Economy's New Technology and Market's team has a role to "lead information economy policy development by identifying and analysing trends ... likely to have major impacts on (the information economy)". They have a major project specifically on developing a knowledge management strategy (NOIE, 2000), and knowledge management remains a top five issue for CEOs in industry surveys.

Obscuring its potential significance however, is the dash for consultants and academics to "be in it", to publish or reinvent past work in its name, to claim relevant expertise under its embracing remit. Coupled with the ease with which this can be done nowadays, the cynical perception of the field would suggest it as faddish, but instead this flurry may actually reflect its historical importance, its dynamic range and integrative potential.

Some academics have attempted to define the field, limiting it to a particular view, others have admitted inclusive definitions, embracing huge fields with their own traditions, whilst yet others have seized a moral high ground, commenting on all this from a detached perspective. Some have conflated knowledge management with information management, extending a data orientation, whilst yet others look at valuation of intangible assets and reference it to notions of intellectual capital and economic theories. Others look at knowledge philosophically, and extend it to other aspects of human knowing, (such as emotional intelligence), whilst others view it practically as corporate wide exercises in document imaging and linking. Businesses, products, consultancies, portals, masterclasses, degree and premium short courses, journals and conferences abound. References may readily be found on all of these, but the point here is not to review or classify the field. Instead, the aim is to illustrate

that many people, not only from traditional academic disciplines, but also businesses and governments, are taking the notion of knowledge management very seriously, and many technologies are being leveraged in this context. So certainly knowledge management is no fad, but what is its *role* in the information economy?

To answer this, some working assumptions and identification of an intellectual stance is required. It is good academic practice at the outset to state one's philosophical assumptions, insofar as one is aware of them, as they will condition the methodologies and interpretations in research. My stance on human knowledge is a constructivist one: that humans confer meaning on data to produce information contextualised for specific purposes. The distinctions they make, their utility and value are provisional, contextualised, contingent and intersubjectively referenced. Pragmatically, and academically, constructed human knowledge of the sort characterised in the domains addressed by "knowledge management" does not meet truth conditions, and refers rather to a particular and glorified type of information management. In my epistemology, the word ***knowledge*** properly connotes true belief, timeless relevance, freedom from cultural limitations and ineffable and absolute qualities beyond any symbolisation. It also has stability and a certainty that distinguishes it from temporal constructions of information. To paraphrase Winston Churchill, many researchers have stumbled over the truth, but have usually picked themselves up and pressed on as if nothing had happened. Likewise, despite my "reserved word" status for the concept, the *knowledge* being managed in knowledge management is viewed as a convenient shorthand term to describe the actuality of human knowledge under consideration. Unfortunately there is a propensity within sections of the literature to attempt to fix organisational knowledge as a unitary truth to guarantee consistent decision making which knowledge based DSS must go beyond.

Managing knowledge is also a predominantly Western idea and itself a problematic concept. Ikujiro Nonaka, the world's first "Professor of Knowledge", unlike his sponsors, preferred *knowledge creation* to *knowledge management* as his professorial title, hence the compromise. Western management styles based on control and instrumentalism can be contrasted with Eastern, especially Japanese, styles emphasising information sharing, consensualism and organisational learning (Nonaka and Johansson, 1985). Many knowledge management technologies can be used to facilitate and support both types of management style. Cultural influences on use and uptake of technologies will be critical to identifying the role of knowledge management in the information economy. Australia provides an interesting cultural mix in this regard, being a Westernised nation, in an Asian context, with indigenous traditions, and with immense potential to establish its own approaches. And as a relatively small economy, managing its unique strengths and the quality of its knowledge base will be paramount. So the role of knowledge management in the information economy will be culturally and socially conditioned, and not simply technologically determined by dominant forces.

If we view (organisational) knowledge as a social construction, rather than a derived property of data, there is a chance to develop technologies and processes for effective decision making at organisational, governmental and community levels. Modelling on a flexible basis which is publicly understood, owned and accountable, with scope for evolutionary change, learning and reflection on practice escapes the tyranny of instrumentalist technologies. Instrumentalist technologies, such as expert systems,

often epitomise a dictatorial approach to knowledge and decision making, predicated on a naive realist view of knowledge as correct symbolic correspondence to the physical world. But studies in the sociology of science show how knowledge is essentially situated in local contexts, and attempts to define universal codes break down as they are recontextualised. Hanseth and Braa (forthcoming) describe this in relation to IT infrastructure standards, which are often taken as a foundation for knowledge management systems. There is a critical dichotomy between the need for a certainty of reference points and recording structures, and the fluid dynamism required in operating and making informed decisions in active contexts.

It is this tension which I wish to explore in the remainder of the paper. Theoretically the Habermasian distinction (Habermas, 1984) between communicative action and instrumental action is also found relevant, and is helpfully summarised in an IS context by Gunatunge and Williams (2000). When knowledge and human labour is appropriated to "get things done", instrumentalist or coercive forces are at work, and technologies are designed and used in that service. In communicative action there is a greater emphasis on obtaining true consensus, where an intersubjective understanding is gained. Although perhaps an impractical ideal for most organisations, deeply shared knowledge will outlast attempts to dominate by imposing a fixed order, and forms a more useful basis for decision support. Designing decision environments in which organisational knowledge can be managed is the main theme of the research here.

Knowledge management and decision support systems

In this section, I trace by way of examples, some types of knowledge based systems used in decision support, and consider their applicability in knowledge management. Examples are limited to support systems dealing with linguistic or knowledge based categories, and apply in domains which are neither simply nor essentially reducible to equations and formulae, and where potential for human factors in decision making is evident.

Expert systems epitomise many of the business and technological motivations and assumptions behind more recent, subtler forms of decision support. They were originally conceived as rational decision makers, individualistically applying logical deduction in a domain to arrive at conclusions or recommendations. Modelled logically on production system architecture, their strength lies in discriminating categorically among alternatives in a closed world. If expertise is equated with specialisation, and specialist labour was both costly, vulnerable to death or job migration, hard to replace or dispense with, the motivation for capturing it within the organisation is clear. Secondary uses in training and documentation, and in freeing the time of experts from routine labour were also identified.

One set of studies, (Gammack, 1988) looked (*inter alia*) at information retrieval experts in a large, multinational pharmaceutical company. This domain had been chosen, as previous knowledge elicitation exercises had started to uncover knowledge (!) which was deemed commercially sensitive. So a "neutral" domain of searching in various scientific information sources was examined, using interviewing, "sitting by Nellie", card sorting, repertory grid and other cognitive science techniques. However, even here, searches were restricted to contrived topics, as an actual search of (say a specific drug research in an offshore medical library), if publicised could alert the

competition. Even a plausible surrogate for a drug of interest would convey the type of search strategy, and the family of drugs being researched, which is sensitive commercial intelligence. Here an expert system was not produced, but documentation and a classification of information sources and their discriminating attributes was. It was apparent however, that choosing which source to search was negotiated with the scientist, context, time and resource dependent, variable as new information came in from searches, and essentially not algorithmic or rule based. As digital libraries and web searches become commonplace, and third party search engine providers and their commercial partners record search terms, patterns, frequencies and co-occurrences (with or without identifying personal information), the secrecy of searches in public domain sources is compromised. In the drug search example, offshore medical libraries which charge for access would require securities, protocols and binding ethical codes at the very least for the equivalent to the assurance of an in house facility. Yet only governments or the largest companies can support such facilities.

In another project, where several expert systems were linked serially to assess insurance risk, weaknesses emerged from the modular design (Gammack 1992a), based around the independence of factual data outside a specific contextualisation. Australia might be a "low risk" country, and a rancher might be a job of scoped risk. Module testing on "geography" and "occupation" might be passed successfully, but the interaction of those two specific values may not be detected in integration testing. An Australian rancher may be particularly subject to skin cancer (outdoors exposure risk), and may be likely to fly single-engine planes landing on rutted ground in remote and desolate areas. Together the combination of values suggests specific risks, but this is general knowledge not captured in the representation. A combinatorial explosion would result in developing such rules.

The limitations of the expert systems approach in decision support became increasingly obvious, and as expert systems made the transition to products and applications, their limited utility became correspondingly identified. Whilst they may play a specialised role in some applications, they are unsuited to knowledge management in a wider sense.

One subsequent development was the IDIOMS (Intelligent Decision-making In Online Management Systems) project (Gammack, 1992b). This explicitly aimed to overcome the weaknesses of (1) knowledge elicitation limited to a single expert (2) obsolescence/failure to learn (3) user passivity (4) guesstimated certainty factors (5) ignorance of context and (6) unadaptability by users. At the same time. organisations were beginning to realise that they had massive amounts of data which was an untapped resource. The design concept was to develop a management information system that accessed the corporate database to identify historical trends, frequencies and patterns relevant to a current decision. Rather than simply build a domain specific application, IDIOMS aimed to develop an environment in which business decision models could be built and tested on the corporate data base, and then saved as an knowledge based decision system if appropriate. The run time environment was on line, since the corporate database (i.e. a major bank's transaction processing system) was in constant use, and it was impractical to expect sufficient downtime to be available for development and testing.

Fuller details of this work are given in (Gammack et al, 1992b), and this type of decision support system, based on data mining and knowledge discovery, has many advantages, although in this form it is largely restricted to a single business modeller (user) and an in house database of expertise. Negotiable information, and the considerations of groups of stakeholders and third parties, as well as the time dimensions, accountabilities and activities involved in enacting decisions are not covered within this model. If these are the sorts of situation occurring in virtual or distributed organisations, an extension to distributed architectures, group support systems and participatory approaches is required.

The essential architecture of IDIOMS was designed for parallel and distributed processing, and implemented on a transputer surface making use of RAID (redundant arrays of inexpensive disks) technology. Furthermore, the constraint graph based representation of knowledge allowed for a conceptually scalable set of distributed nodes interfacing through identified channels. Such channels are conceptual, and meet the general criteria for any organisationally distributed architecture. In virtual organisations, such structures are considered suitable for knowledge management.

The final case study continues the theme of providing an environment in which the knowledge and information relevant to making decisions can be communicated, shared and acted upon. Here the application domain is industrial design, particularly marine engineering, but applicable more widely. A major motivation for the work was that design decisions made at any stage of product development, but especially, the early, critical decisions, were referenced to a rationale, to the organisational memory, and were auditable and inspectable to levels that allowed intelligent critique.

Following interpretive analysis using ethnographic inquiry methods, in which designers' behaviour was observed, our team designed an online design journal, which facilitated the organisational change required towards a groupworking virtual environment. Designers continued to make sketches or construct spreadsheets using existing tools, but these journals could be shared over a network by authorised project teams, and immediate feedback obtained by other designers on the project. Full keystroke capture and application sequence information was retained, and periodically senior designers would review this, abstract any patterns and save a project record for organisational learning. Since design rationale was captured, future similar projects could consult a retained memory of why decisions were made. Such reflection allows organisational constructs to be identified, and this becomes the basis for an organisational memory, a fundamental requirement for knowledge management.

Conclusions

A clear evolutionary path is shown in the above chronology towards component based systems, which interact flexibly around organisational structures to inform decision making in current contexts. Dependence on disembodied data is avoided, awareness is emphasised through the use of interpretive and constructivist techniques around the organisational data itself. In constructivism, knowledge is known by knowers, and not otherwise, and effective knowledge management must make provision for this to take place. I would argue that knowledge management must use constructivist techniques, on epistemological and pragmatic grounds, and speculate in this final section on the relevance of this to the nature of organisational decision making.

It is self-evident to managers and others in governance positions that fully consensual decision making is impractical when timeous decisions are to be made. Processes of erosion, culture change and evolution occur, but take longer. When the utility of organisational knowledge is referenced to economic objectives there will almost necessarily be a use of instrumentalist ideals in relating that knowledge to organisational purposes. Organisational purposes provide the context for the selection and interpretation of data, information, abstractions of information or tips, tricks, trade secrets and knowhow, however elicited, and individuals are used within that. There is a requirement, for the organisation's integrity and continuance, to impose an order and a meaning on its information, and this, an organisation is bound to do.

Morgan (1986) identified several powerful and useful metaphors for "reading" organisations, and his enduring insights apply widely. Now however, when virtual organisations provide very different environments to those of traditional organisations, and the information system *is* the organisation, the knowledge informing decisions is not easily referenced to an organisational culture, a shared history embedded in common experiences or an obvious seniority or accreditation. Decision-making can become fragmented, and the value added by partners or components of the organisations is associated with their specialist knowledge. As universals (single order of knowledge) are theoretically rejected in social studies of science, it would appear that imposing a standard will be doomed as Hanseth and Braa (forthcoming) have discussed. However, reworking the notion of universals in local contexts may be more fruitful, and Hanseth and Braa point to work by Timmermanns and Berg (1997) that does just that.

In such a context the organisation may be more usefully viewed as an integrator, with "local universals"(Timmermanns and Berg, 1997) providing the integrative constructs within which individuals must operate. This sees governments, quangos and multinationals taking a lead in providing generic frameworks and publicly understood standards as an order within which the private sector and citizens work. If these constructs emerge from the community they will be understood, and likely to give emphasis to the enduring public interests, including wealth, freedom, quality of life, seniority, safety, effectiveness and other primary structuring concepts. At organisational levels, the major social constructs may be less applicable, but similar processes apply. In the DUCK project for example, reflective practice on design histories and decision-making allowed the organisation to abstract patterns for recording in its memory processes. In IDIOMS, patterns of experience could be extracted though intelligent query formulation, and linked with tacit or newly reified knowledge. Although there may be no one universal order, and the competition to define standards can be expected, cultures will adapt around, and adopt as suits with organisations formulating the specific terms around which their core knowledge is held. Designing decision environments in which knowledge can be constructed at these levels is thus seen as a key part of the activity of knowledge management. These themes are explored further in Gammack, Beeby and Crowe (forthcoming).

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