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Knowledge mobilisation in communities through socio-technical system

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Knowledge Mobilisation in Communities through Socio-Technical Systems

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Abstract

Enterprises in both the public and private sector undertake knowledge management (KM) initiatives through which they hope to engender a new, more adaptive and flexible culture of learning and innovation in their organisations. Creative activities involving social learning and innovation are, however, more common in less formal entities such as communities of practice at work and community service organisations in civil society. This paper presents the results and implications of collaborative research into the understanding, development and evaluation of socio-technical systems (STS) designed to mobilise collective knowledge in diverse community settings. The research concerns information and communications (ICT)-mediated activities of communities in the broader civil society and also those in formal organisations. The paper describes and critically evaluates a set of three STS that have the potential to support the collective knowledge of innovative groups, teams and networks, which can all be considered forms of community. The findings could be of strategic value to business, government and community service organisations initiating KM programs aimed at using collective learning to support innovation.

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INTRODUCTION

This paper reports on the findings from a five-year collaborative research endeavour in the field of knowledge management, focussing on the development of socio-technical systems, which support knowledge mobilising activities in learning communities. Recognising the association of knowledge with activity, the broad aim of the research is to understand and develop systems that genuinely enable knowledge creation by increasing an individual, or group's, capacity to take effective action. During the conduct of the research, innovative technology has been developed, not on its own, but as a component in broad socio-technical systems that support and promote knowledge mobilisation in communities.

As the title indicates, this paper has three foci, each of which extends commonly held views on knowledge management into territory that may challenge convention and be of value to the reader. The first of these is the use of the term mobilisation shifting the focus from traditional management to the provision of space that enables people to act and apply their sense making, toward greater collective understanding and where people make decisions together to achieve genuine outcomes. The second focus is the notion of socio-technical systems, which we approach not merely as a duality between people and technology but rather as a mediation of human social activity by technology-based tools. Thirdly, we contend that the most exciting level of KM on which to focus and develop systems to support knowledge creation and innovation, is the level of a group or community rather than on individuals, on the one hand, or a whole organisation on the other.

This paper begins by providing a background to the notions of knowledge mobilisation and socio-technical systems as well as justifying the emphasis on groups and communities as the site of creativity and innovation. This will be followed by the methodology, results and implications of research into the development and

evaluation of the socio-technical systems designed to support knowledge mobilisation in communities. The paper describes and critically evaluates a set of three STS that have the potential to support the collective knowledge of small innovative groups, teams and networks. The findings are then discussed in light of their strategic value to business, government and community service organisations initiating KM programs aimed at using collective learning to support innovation.

KNOWLEDGE MOBILISATION

In the field of knowledge management there is a continuing debate on the nature of *knowledge* in the current context, as to whether it is the sole province of individuals or can be considered an asset of organisations. We believe that it is useful to adopt the pragmatic approach of Davenport and Prusak (*ibid*) who begin their book by observing that "knowledge is not neat or simple". "It originates, and is applied, in the minds of knowers" and "in organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, practices and norms". This would indicate that part of the debate over the interpretation of the term 'knowledge management' stems from the presumed dichotomy between the individual character of 'knowledge' and the formal organisational focus implied by the concept of 'management'. As to the latter, Benson and Standing (2001) have concluded that most management engages in harmful knowledge practices, adopting reward structures that encourage workers to be selfish and competitive in nature. It is not in a worker's interest to be altruistic and share knowledge within organisations and this represents a loss to the organisation. In contrast to earlier notions of knowledge as something owned and traded by competitive individuals, Coakes (2002) talks about knowledge as the capacity of an organisation and its staff to act effectively. It is this more dynamic notion of knowledge in context that justifies the use of the term 'knowledge mobilisation' rather than 'knowledge management' and is an appropriate platform to support active notions of creativity and innovation.

There are two substantial bodies of work that form a background to our initial work on KM namely; the SECI framework of Nonaka (eg Nonaka 1998) and the concept of Communities of Practice (eg Wenger et al 2002). However in the bulk of our work we rely heavily on Activity Theory to support the emphasis on action and mobilisation, rather that management, where knowledge is concerned. This theory originated in Russia in the early part of the Twentieth Century but came to prominence in Western Europe in the 1980s, with the work of Engestrom (1987). Engestrom proposed a new unit of analysis in the concept of object-oriented, collective, tool mediated, and culturally mediated, human activity system, in order to be able to analyse complex interactions and relationships within work communities. Here "activity" is interpreted from the theory of Leontiev (1981) which is, in turn, based on the psychology of Vygotski (1978).

According to Leontiev (1981), activity should be placed at the top of the hierarchy shown in Figure 1, associated sustained human endeavour with a long-term purpose and strong motives. An activity is comprised of sets of actions (towards specific goals) and operations (routine and well known habitual cognitive or behavioural processes, now commonly the domain of IT systems). Where as an activity is defined by purpose and motive and is typically a long-term affair, actions are more planned with specific goals and a more limited time span. Actions are not meaningful in themselves unless they are part of an activity.

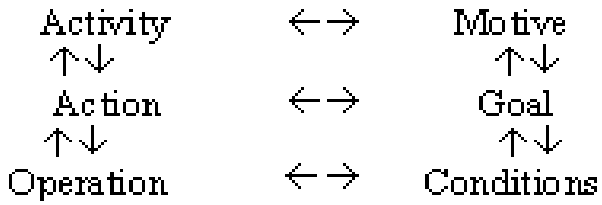

Figure 1 The definitive hierarchy of Leontiev (1981)

Engestrom acknowledges that the internal tensions and contradictions of such an activity system, which includes both historical continuity and local situated contingency, are the motive for change and development. In a similar fashion to the SECI spiral of KM (Nonaka 1998), Engestrom introduced the notion of cycles of expansive learning whose dynamics and phases are of crucial importance to the historical understanding of activity systems. These cycles combine the process of internalisation and externalisation where internalisation is the reproduction of culture by socialising and training individuals to be members of the activity system, and creative externalisation is the creation of new artefacts through innovations. Knowledge Mobilisation, in these terms, reflects the notions of activity systems and cycles of expansive learning where communities are able to respond productively to change and work within complex socio-technical systems for regeneration and growth. This theoretical position also implies that all human activity combines learning with doing.

SOCIO-TECHNICAL SYSTEMS

The term socio-technical is commonly applied to the study of the relationships and interrelationships between the social and technical parts of a system, particularly within organisations (Coakes 2002). The socio-technical movement flourished from the 1950s to the 1980s; a highlight being Cherns principles which included concepts of minimalist design, multiple perspectives, support for congruence, consideration of information flow, and human values. (Cherns 1976). In the 1980s a divergence developed between the European or Scandinavian approach, associated with the democratisation of work and systems design around the time of the Utopia project, and the North American approach, associated with joint application design (JAD) and cognitive science.

Because of this uncertainty, a number of researchers, including ourselves, refrained from using the term 'socio-technical'. We now think that was unfortunate because the term effectively expresses the intricate relationship between the social and technical elements of any information system. A recent overview, in the Scandinavian tradition (Coakes 2002 p6) describes the goal of socio-technical design as to produce systems capable of self-modification, of adapting to change and of making the most of the creative capacity of the individual for the benefit of the organisation. Scholtz (2002) also sees the socio-technical perspective as valuing small independent work groups engaged in highly varied tasks, managing their own activities and often supported by technology. These descriptions resonate with our work and agree with the notion that, from this perspective, the applicability of socio-technical principles and the methods of applications associated with them help organisations to explore conflicts and complexity in the human, organisational and technical aspects of change (Coakes 2002).

In a well-known KM text, Davenport and Prusak (2000) acknowledge that most firms make their first move with KM in the domain of technology, and, although they cautioned against a technology-centred KM approach, they

state that a technology infrastructure is a necessary ingredient for successful knowledge projects. They also warn that knowledge behaviours sought from users of knowledge systems may be slow to emerge.

It is our contention that a focus on KM technologies, without consideration of the social processes that surround them is a recipe for failure. However, bringing together the social and technical demands of systems is not easy. As observed by Benson and Standing (2001), staff will develop and information systems in a purposeful way but the social system, which underpins most of the day-to-day operations, develops in an ad hoc fashion.

KM systems routinely adopt different social roles within an organisation and these roles have a major influence on a system's acceptability (Masterton & Watt 2000) Many are groupware systems, which either connect people to people directly or indirectly, through sharing knowledge. In our research we assume that the ability of ICT to provide support for KM are best understood as the interrelationship of organisational, cultural and technical elements. (Boland & Tenkasi 1995). What is more, we distinguish between KM systems as artifacts (an end product or outcome of a development activity) and as an evolving tool that mediates, and is mediated by, the activity for which it is used. According to Activity Theory, all human activity is mediated by tools and there is an intricate dialectic relationship between tool development and human activity. A significant aspect of our work is concerned with the social and organisational factors that may underpin successful systems development through an evolutionary process that is cognisant of this relationship. We believe that investigation of these issues necessitates a sound understanding of culture and relationships, human social interactions, and communication where socio-technical systems are considered as an integrated whole that enable creative process to occur.

THE FOCUS ON COMMUNITY

The Australian Standard defines KM as “A trans-disciplinary approach to improving organisational outcomes and learning, through maximising the use of knowledge. It involves the design, implementation and review of social and technological activities and processes to improve the creating, sharing, and applying or using of knowledge” (AS5037-2005) where an organisation can be “a group, team, business unit, department, community, government, charity, sports club, or any other for-profit or not-for-profit collective or network that may take part in knowledge management” (AS5037[INT]-2003). This breadth of applicability of KM is often overlooked as a great deal of writing and discussion on KM assumes its application in government or large firms. The research presented in this paper considers KM issues in and among communities of people, which could be within government or business organisations but need not be.

There is a growing body of literature (Boland & Tenkasi 1995, Engestrom 1999, Toulmin 1999, Wenger et al 2002), which promotes a view of socially-constructed, collective knowledge as the predominant source of learning, creativity and innovation. Moreover this focus promotes knowing as an activity by specific people in specific circumstances for a specific purpose. Such desirable outcomes are commonly achieved, not at the organisational or individual level, but at the group level in work units, cross-functional teams or informal groups of people who have come together with a common interest or shared purpose. It is not surprising then that the expressions “community of interest”, “community of learning” and, most significantly, “community of practice” have captured the attention of many in the area of KM. Communities are collections of people that engage in activities that encompass a common interest and ongoing learning through practice, not in their leisure time, but

also as part of their work as employees of organisations. There is a business imperative for intellectual capital creation which is a socially constructed dynamic process of situated collective knowing that is capable of being leveraged into economic and social value (O'Donnell et al 2003).

As has already been stated concepts that have strongly influenced our work are those of the SECI interactions (Nonaka 1998), Communities of Practice (Wenger et al 2002) and Activity Systems (Engestrom et al 1999). We have adopted both as the focus of our current research and believe that these are different views of the same reality: Communities of Practice as a practical concept mainly associated with professions and large organisations and Activity Systems, a concept emerging from a rich theoretical base. Chae et al (2001) also describe human activity systems together with the terms communities and networks of practice as relationships among persons, activities and worlds. A community is fundamentally a self-organising system embodying the key elements of communities, namely practice and identity. In our focus on communities as a locus of activities of creative knowledge generation we are encouraged by researchers (Linger & Warne 2001; Cecez-Kecmanovic & Jerram 2002) who distinguish this intermediate level, between individual and organisation, as important to increasing the understanding of KM in its broadest sense.

RESEARCH APPROACH AND METHODS

In searching for research methods appropriate to the study of dynamic, self-organising and diverse communities through the development of complex and evolving socio-technical systems, we are in accord with the notion of a "New Scholarship" (McNiff 2000) where there is a new way of knowing that meets the everyday needs of people working in real-life situations. Real-life practices are messy, uncontrolled and unpredictable and are seriously separated from the sanitised world of abstract theorising. McNiff (ibid) proposes that learning from experience, although not highly valued by the academy, can be reinforced through intellectual study and contrasts this to traditional forms of scholarship, which values facts and information and is generated by conventional kinds of research which tests knowledge against standardised criteria of hard scientific analysis and techniques.

We have therefore adopted an approach to our research rooted in reflection-in-action, which implies that the research will be participatory, evolutionary, contextual, holistic and developmental. The developmental research method involves disciplined investigation conducted in the context of the creation and implementation of a product or program, in our case a socio-technical system and model, for the purpose of improving either the thing being developed or developer. It is holistic, contextual and evolutionary, incorporating many forms of data collection and analysis. To study the activities of a community enabled by a socio-technical system a prototype model is constructed, used with the target group, then analysed through participatory observation before the prototype (both technology and social system) is revised. The form of prototypes of socio-technical systems can vary from very low fidelity, non-technology based, ones that do not resemble the final product to very high fidelity systems using advanced web-based applications (Preece et al 2002).

This approach is influenced by the expanding spiral of learning in the developmental work research (DWR) approach (Engestrom 1987), where communities of learning and practice are viewed as activity systems (Virkkunen & Kuutti 2000). DWR provides a dynamic framework that can accommodate a multifaceted analysis of the community members, their motives and purpose for belonging, their relationships within the community and the tools that mediate community activity. In our research the tools are systems that integrate technology

together with social and learning processes. Discipline is imposed on our investigation by the analysis of each case as an activity system, in the tradition of the Cultural-Historical Activity Theory so that an activity system the unit of analysis is the work activity itself, which is culturally and historically located. The work/learning activity system is comprised of the following components:

- the purpose to which members of the community direct their activity
- individual workers/learners, their colleagues and co-workers/learners
- the conceptual models, tools and equipment they use, and
- the rules, culture and context that govern how they work, and learn through their work

The work presented in this paper only makes sense in the context of the historical development of the research. The research history is therefore summarised in the next section. This is followed by a description of the main contribution of the paper, involving the emergence of three socio-technical systems that appear to meet the requirements for tools that support knowledge mobilisation in communities. The research process has been guided by the model depicted in Figure 2. Throughout the research, qualitative data has been collected through observation, transcripts of online discussions, focus groups, workshops, regular polling of community members, and in-depth interviews. The data analysis and reduction has been aided by content analysis and other tools before summary, interpretation by the researchers. The results are then fed back into the next iteration of the research. Much of the research output is realised in the conceptualisation and design of subsequent versions of the socio-technical systems and so this constitutes the 'data display" component of the model in Figure 2.

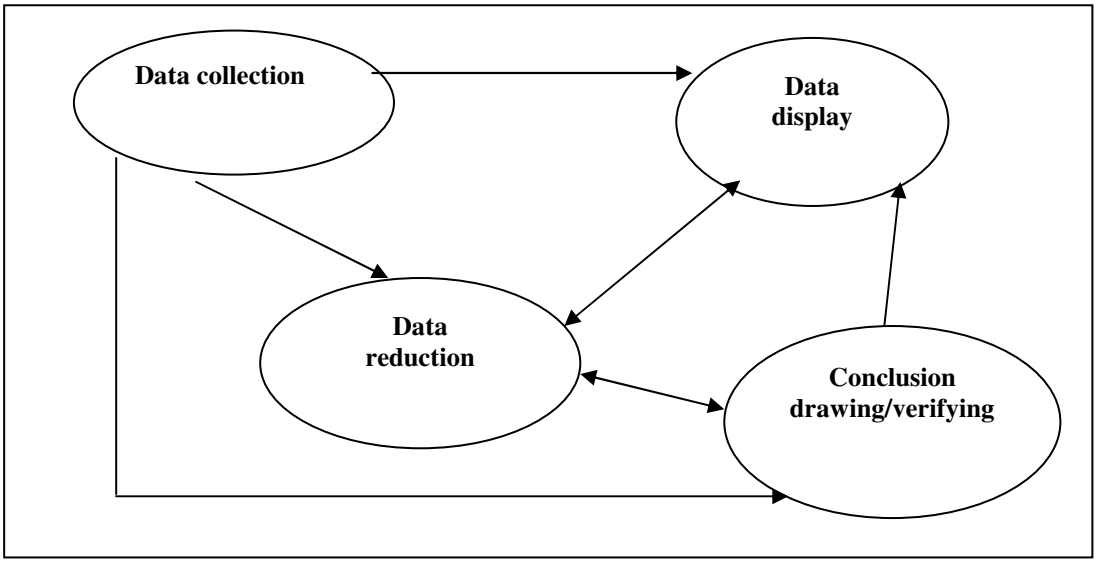

Figure 2 The iterative qualitative data analysis model (Miles and Huberman, 1994, p12)

EVOLUTIONARY DEVELOPMENT OF THE RESEARCH

Background Research

The original aim of this project was to investigate the capacity of ICT to support knowledge creation for innovation in modern organisations. The plan was to iteratively develop prototypes of flexible computer-based

systems and evaluated their usability and suitability for the support of knowledge workers. The results were interpreted to determine how the systems contributed to organisational learning, performance, and responsiveness to change. Over the five-year course of the research global and local environments have changes and the research has adjusted accordingly. From organisational learning the focus expanded to knowledge management at the organisational and then to knowledge work at the level or group or community. The initial emphasis on technological systems reflected the background of the investigators in traditional Information Systems (IS). However the human and organisational aspects of IS made the transition to an emphasis on socio-technical systems quite seamless.

The preliminary research for this project, built on the diverse skills, experience and recent research activities of the members of the research team, included:

- ethnographic studies of social learning in command and control in strategic and tactical settings of the Australian Defence Organisation (ADO) (Warne et al 2002a) The authors have been members of a reference group for this project and participated in workshops to evaluate these architectures (see for example HICSS36 2003).
- investigation of the relationships between organisational structures and the use of executive information systems (EIS) in corporate and public sector organisations, with an awareness of their role in strategic decision-making (Hasan & Gould 2001).
- an exercise in experiential, team-based learning for creating awareness of the new science of Photonics amongst communities of high school students and teachers in a large city. (Hasan & Crawford 2003)

Although large private and public sector organisations were involved in these studies the results of this research guided the research to the current emphasis on knowledge mobilisation in communities both within large corporations and in the wider civil society. The ADO study showed that the overarching organisational values that formed part of the cultures that most effectively supported social learning and KM invariably included the following:

1. empowerment (where empowerment of staff also makes them accountable);
2. trust (which entails mutual respect);
3. forgiveness (in terms of allowing personnel to take reasonable risks, forgiving mistakes and facilitating knowledge construction on the basis of lessons learnt);
4. cultural cohesiveness (in terms of common identity, shared goals and a shared understanding);
5. commitment (which includes a mutual commitment and loyalty from the employee to the organisation as well as the organisation to the employee);
6. openness of the decision-making process; and
7. a culture of information sharing.

These values are clearly central to effective social learning and organisational performance, and are needed to underpin the enculturation of individuals and communities within an organisation that wants to be creative and adaptable (Warne et al 2003). As depicted in Figure 3, the diffusion of values from the macro level of the learning model to the meso and micro levels provides a consistent narrative that underlies social learning and

knowledge management in the organisation. The research recognised that the meso or community level is critical in these processes but is particularly complex and has not received as much attention as it warrants. Similar results were found in the EIS project (Hasan & Gould 2001) when the data analysis was conducted using an activity theory framework. Collective 'community' activities of executive decision-makers, internal information providers and technical EIS developers were seen to interact in a way that explained otherwise inexplicable breakdowns in the process.

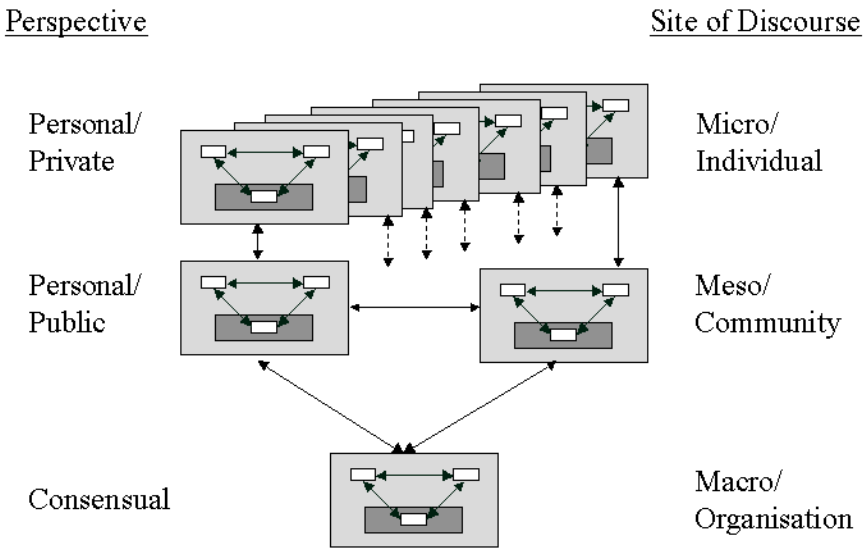

Figure 3. A layered architecture for a learning organisation (from Warne et al 2003)

In the Photonics project, scientists, business developers, teachers, technologists and business people contributed to:

- Intensive workshops with input from all participants and including community-building exercises and heterogeneous project team formation. Their project was to create a website that could be used to inform other students about Photonics.
- An online period of sustained creative activity as new materials are assembled and knowledge is exchanged by the teams online. A proprietary web-based message, discussion and document storage system was used for this.
- Community celebrations where young people show their creative work and explain their new learning and interest to members of the community including politicians, local government officials and the media.

This experience was subsequently encapsulated in a socio-technical model, which was used to support a number of work/learning communities as case studies to provide data for the research. The model begins with a face-to-face workshop followed by a period online where learners, experts and instructors are linked by a special-purpose, Internet-based communication and group-support package. During this period the community of workers and learners undertake a team-based, problem-solving project where experiential learning takes place through the generation of skills, ideas and solutions.

As this community-focussed research continued the cross-institutional team of researchers conducting the project quickly came to the realisation that they were themselves a small community concerned with knowledge creation and were managing their own knowledge with a mixture of face-to-face meetings and online communications. The knowledge and experience in the application of the Cultural-Historical Activity Theory to IS, and hence socio-technical systems, can help us discover how to build socio-technical management systems that genuinely support the creation of knowledge in communities through a nexus of learning and practice.

THE EMERGENCE OF 3 SYSTEMS

Over the duration of the project, two research activities have been running in parallel, both iteratively utilising their research findings to improve evolving prototypes of two socio-technical systems. Some preliminary results of these activities have already been published (Hasan 2003, Hasan & Crawford 2003a, b). However, the development continues to advance. This section of the paper discusses how the two systems are now converging conceptually and leading to the need for a third component as will be described below.

Socio-Technical System One – a Knowledge Repository

The object of one of the two parallel research activities is a system named UniStore, the purpose of which, as its name suggests, is to act as a knowledge store. The concept of treating knowledge as an object that can be captured and stored is quite contentious (see for example Walsham 2005) particularly when the knowledge management system is viewed as a piece of technology. If, on the other hand, the system is recognised as socio-technical, it makes more sense to talk of a knowledge management system. In this case data and information on the historical activities of a community are entered into digital storage which can be accessed and interpreted as knowledge by the social components of the system, ie the people. In UniStore, an activity-based model of knowledge processes is created using 'activity' as the unit of analysis in the manner of Activity Theory where the collective subject of such an activity or activity system is a cohesive group of people working together over an extended period with a common purpose. Using the activity model, the prototype of a knowledge repository for such a community has been created and evaluated for its suitability and effectiveness (Hasan 2003). The elements of the activity-model are:

- Activities: who is doing what, for what purpose

- Components of each activity: subject (the doer), object (encapsulating purpose), tools, outcomes,
- Relationships between those activities.
- Actions and operations (see Figure 1) by which activities are carried out
- An historical record of the above elements

The mechanical part of the model has been implemented as a prototype, (see Figure 4), in currently available technology and is being evaluated as part of an ongoing evolutionary development process. Users can create their own activities and store data in each of the elements for that activity, such as the people (subjects) the purpose (object), planned actions and add notes on any of these at any time. Reports can be generated according to any of these elements, for example all the activities and action for one staff member during the year for their career development record. Two non-technical issues that have been identified as critical to the success of such innovative knowledge repositories are:

- the motivation of people to continue to enter content throughout the life of the system, and
- the meaningfulness of information and knowledge that can be extracted from the contents of the system

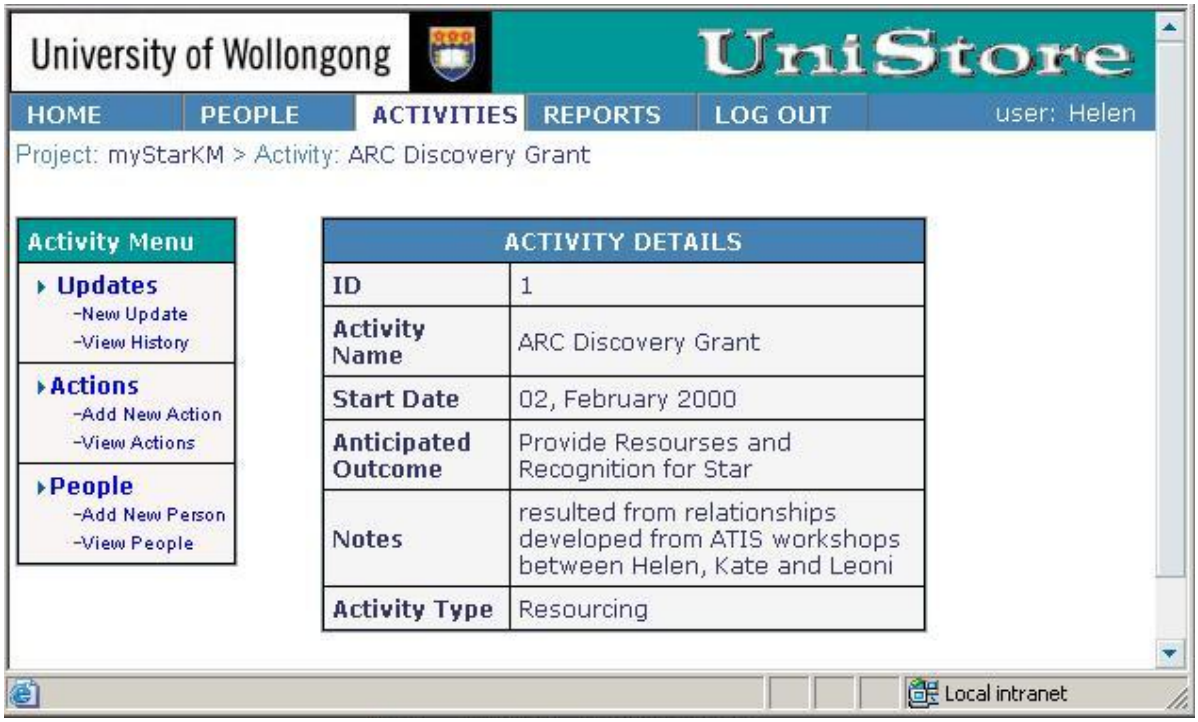

Figure 4 The UniStore Knowledge Repository, with an Activity-based Architecture.

Socio-Technical System Two: a tool for communication and collaboration

A second related research activity has been a developmental approach to the social and technical support for work and learning in diverse communities. A technical tool, UniLinks[1] (see Figure 5), has evolved throughout the research to support this activity. Earlier stages of this work has been reported elsewhere (Hasan & Crawford 2003a, b). The knowledge gained from each stage has led to more sophisticated requirements for an online

support tool appropriate for a wide range of such communities in a variety of settings, many with very low bandwidth access to the Internet. The software package provides 4 levels of participation from super-user to guests and enables the establishment of many communities within which there can be many projects and within those teams. Each community or project can have its own functions of News, Forum for discussion, Storage of documents and Polling. There is a messaging system and most parts of the system are customisable. Anyone can register into the system but must be assigned to communities, projects and teams by a super-user. The social aspects of the system include ways to sustain and develop each group of people as a creative and growing community. Communities using UniLinks tend to follow very different patterns, some going through cycles of enthusiasm, some lasting for long periods of time while others only exist for a short burst of activity. Some members of communities are highly motivated to work together and are relatively self sustaining others survive only with continued facilitation and prompting. There is also a need to recognise when a community is no longer functioning effectively and should terminate. UniLinks has provision for archiving obsolete community activity and the related data.

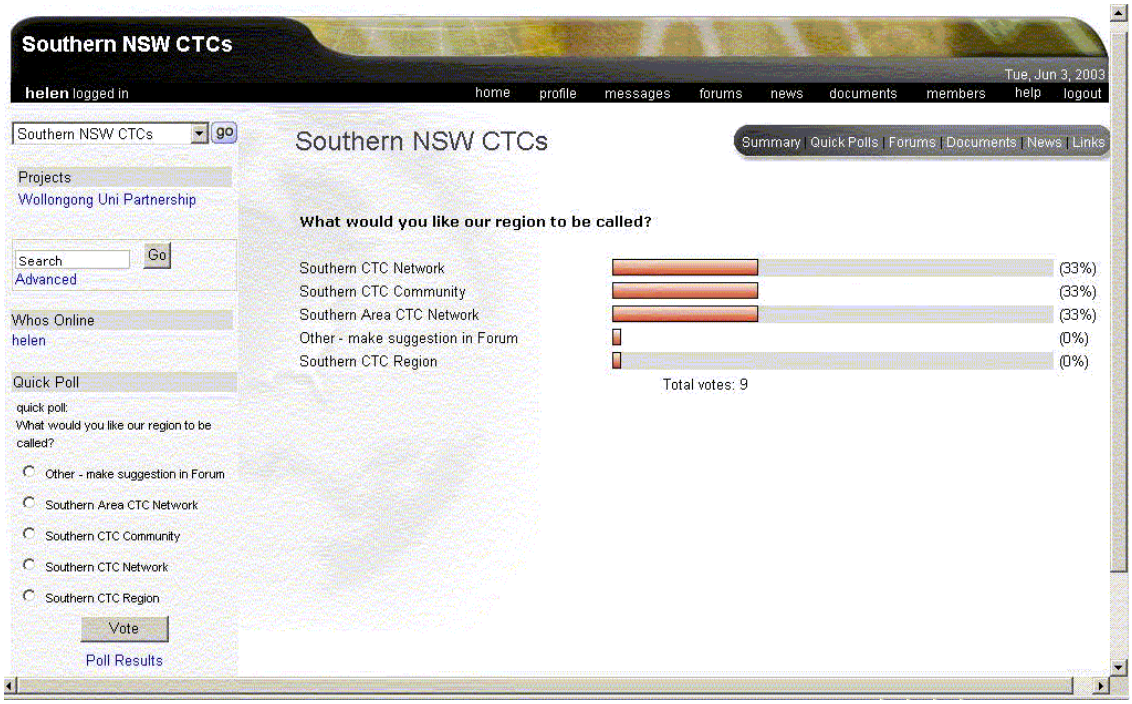

Figure 5 A Poll of a Community in UniLinks

Specific issues emerging from this stage of the project, and which will be taken into account for the next evolution of the socio-technical system for knowledge mobilisation in communities, are:

1. how much intervention should be made by the community sponsor or leader to sustain initial enthusiasm, promote activity or control inappropriate behaviour.
2. what skills and experience are essential and desirable in selecting and preparing people for membership of a community.
3. how can community value be established in order to justify costs.
4. whether there a need to classify different types of communities.
5. whether, and in what ways, online communities that much different from traditional ones.

[1] Now called Eviva. See: www.eviva.com.au

6. the suitability of a separate, closed system for community support, where users must go to the effort of a login to participate, compared with more open environments such their normal email system through which they communicate to everyone else.

Convergence of UniStore and UniLinks and the Emergence of UniPlan.

Although the UniStore and UniLinks projects were conceived and developed quite separately, similarities became apparent in that both were addressing issues of knowledge mobilisation in communities and adopting an Activity Theoretical stance on the social and technical aspects of support systems. There seemed to be an imperative to give communities a holistic system to support both continual interaction (UniLinks) and long-term retention of knowledge (UniStore). The intitial question was: could, and should, the UniStore repository be integrated into UniLinks? More recent developments, bringing together UniStore and UniLinks to better support community activities, are described here.

There was an initial unsuccessful attempt to link the two systems manually by having the same community set up on both systems simultaneously. This proved far too clumsy for users as each system had been developed separately and evolved through separate instances of use with different interfaces and modes of interaction. It has now taken several meeting of the researchers together with a technical development team to bring the two systems together both conceptually and technically. It was necessary to go back to the roots of the two systems in the Cultural-Historical Activity Theory to realise that what was set up as a project in UniLinks was equivalent to an activity in UniStore and to match entities in each system from that point.

As indicated previously the concepts of the Cultural-Historical Activity Theory have strongly influenced the approach taken to the development of both UniStore and UniLinks. Two of these concepts come to the fore in this stage of the research. These are the holistic view that purposeful collective human activity provides as the unit of analysis for research and the role of tools in mediating that activity. As the research has used an interventionist developmental methodology, its outcomes are both the creation of sustainable and successful communities and the improvement of supporting socio-technical systems. This is consistent with the two-way concept of mediation, which implies that the capability and availability of tools mediates what is able to be done and the tools, in turn, evolves to hold the historical knowledge of how the community behaves and is organised. It is through this process that learning occurs, both in the individual and in the society as a whole.

The common basis of UniStore and UniLinks has led us to the realisation that it is at the level of activity or project that the two system converge and it may be possible to link the systems, if not seamlessly, at least conceptually at this level without too much difficulty and in a way that they could be used together by a community. One issue common to users of both systems was the need to view what they are doing from the point of view of a purposeful activity even without any understanding of Activity Theory. Many communities participating in the research seemed to do this, eg set up projects in UniLinks that reflected their activities, as this reflects the way they work However they did not all do this consistently. There seemed to be a need to regularly revisit this issue and perhaps provide prompts within the interface design to maximize the awareness of members of the purpose of their activity.

A third system, UniPlan, is being considered to address the issue of enabling community members to identify, and maintain focus on, their purposeful activities as opposed to goal-directed actions. We are investigating the

adaptation of a facilitated group decision support system (GDSS) to stimulate the identification of the activities/projects at the onset of each community and reviewed at regular intervals. Figure 6 shows the technical interface of the intended GDSS which can be programmed to guide participants through a group planning or decision-making session. Such inherently social processes are not only enabled by the built in features of the real-time collaborative environment but also through the assistance of trained facilitators.

UniPlan is intended to meet the need for some socio-technical means of keeping the focus on activities while community members are planning and carrying out specific day-to-day actions. The next stage of the research will be to observe communities being created with the initial workshops taking into account the improved awareness of the social processes and using the UniPlan system to identity the main activities in which the community will engage. The community will then be monitored as they use UniLinks to communicate and hold material on which they are currently working and as they use UniStore to structure the record of their activities.

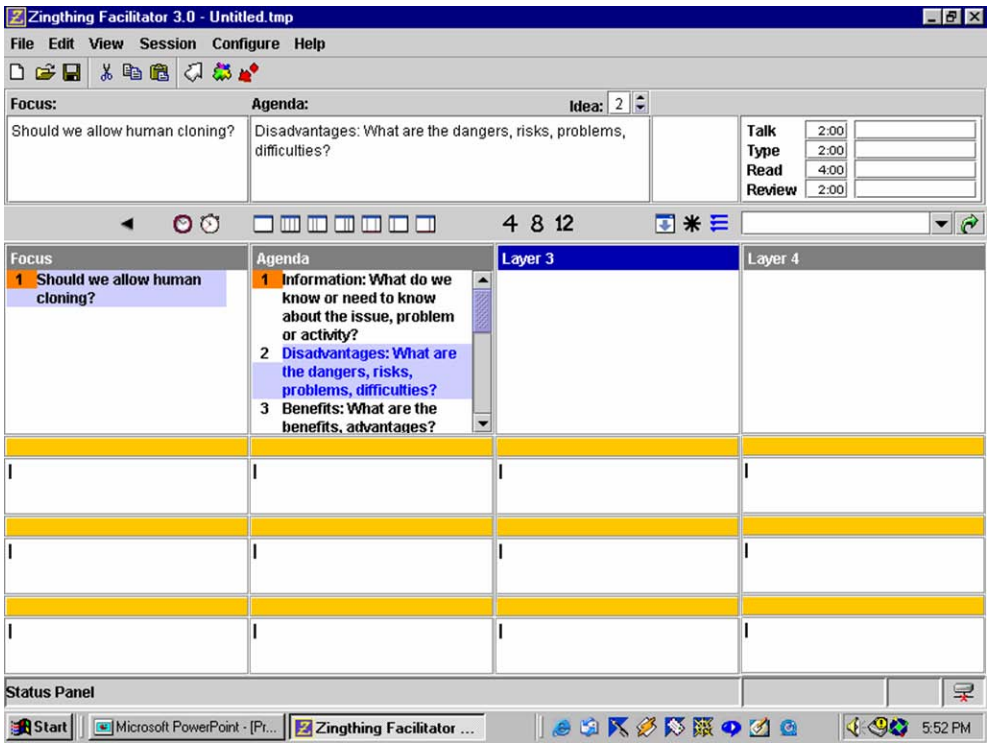

Figure 6 The real-time collaborative environment of Zing[2] which is suitable as a platform for UniPlan

One of the major features of the data emerging from this study was evidence of convergence about the kinds of human skills and capabilities that the technologies need to support. These capabilities for quality interaction, critical discussion, argument, questioning, negotiating, are all essential elements of informal social learning and complex problem solving Activity of all kinds. These capabilities in face to face meetings are a prerequisite to effective use of the extended virtual spaces that are provided by such technologies. Thus not only have we needed to consider essential design aspects of technology development but also the key processes, capabilities, relationships and quality interactions that make it useful as an element in a dynamic socio-technological system.

[2] Zing Technologies Pty Ltd

For example, a major function of the emerging UniStore technology is the support for storing records of ongoing activity and related documentation in ways that can be easily accessed in corporate systems. In the UniLinks system some user groups have confirmed the importance of this function spontaneously by developing Community spaces called 'records' or 'archives' and then listing projects by the names of critical activities and storing the relevant information within. The emerging structure, created by them, fulfils essentially the same function as the specialist UniStore technology though perhaps not so elegantly.

Another emerging dimension in the STS understudy here is the optimum balance between personal or group autonomy and accountability and control. One of the most important attributes of facilitators in the Zing real time meeting and in UniLinks communities has been to encourage group and individual independence and avoid attempts to control the emerging agenda through autocratic behaviour. In both these systems the best outcomes were related to high levels of engagement by individuals and groups. In both cases, levels of constructive engagement reflected the 'space' allowed by authoritative figures for sub groups to use their talents skills and enthusiasm in ways that were meaningful to them. The extension of opportunities, for high levels of engagement and reduced authoritarianism, offered by both systems appears to stem from:

- Extended virtual opportunities for groups to participate around busy schedules or over large distances
- Extended opportunities for less intrusive overviews and observation by senior members of groups since all activity is recorded and remains available for review
- In both cases, the technologies provided increased structure to previously very complex facilitation behaviours reducing the skill needed to support and manage the dynamics of higher levels of engagement, enthusiasm and autonomy in groups.

There is therefore a need to design both the social and technical components of the system together in order to facilitate and encourage community members to act cooperatively and not fall back into individual competition or other hierarchical bureaucratic practices. This design should not only incorporate the social and technical parts of the system in a seamless, ubiquitous manner, it should also strike a balance between maintaining a separate identity and space for the community while allowing individual members to access the community within the framework of all their other work and life activities.

DISCUSSION AND FUTURE RESEARCH

This paper reports on developmental research into distributed communities, framing them as phases of an activity system in expansive learning cycles in the context of a program of innovative learning. This research is uncovering ways to ensure that such communities are viable, with a wide range of benefits, economically and socially. This is leading to the conclusion that, in the electronic age, locally-driven regeneration of the concept of community can be enabled by a flexible, multifaceted model where new information and communication technologies are the catalyst but social demands must be addressed.

It is clear that technology, no matter how advanced, is far from providing the complete answer to the KM needs of communities and it is essential to take an integrated socio-technical approach to this issue. This provides a greater opportunity for innovation as knowledge can only be mobilised through social sphere of activities where work groups and teams take on the characteristics of cooperative communities as determined in the ADO study described earlier (Warne et al 2003), namely: empowerment, trust, forgiveness, cultural cohesiveness, commitment, openness and sharing. In this research, innovative ICT and social systems have been used to

support new forms of activity that meet these several real needs in the community at once and represent an emerging solution of benefit to each of the active stakeholders. The emphasis on mobilisation rather than management of individual and collective knowledge acknowledges the active nature of KM processes, and optimises the quality interaction within and between communities and more formal groups in organisations.

Our technological prototypes, UniLinks and UniStore have evolved throughout this process to the stage where they are now useful and usable technical systems. However they can only grow through the awareness that they are only components of a holistic social-technical system supporting activities of knowing and doing in collaborative, innovative communities. Such communities develop around things that matter to people and an awareness of the high value of quality interaction between people as they create new shared understandings of emerging issues, decide together about new effective responses and develop new ways to reach their goals. As a result, emerging practices reflect the members' own understanding of what is important.

The technical elements can be considered as a 'bionic suit' for individuals that can be designed to extend the scope and power of their activity, and the quality and extent of their interaction, during complex activities. KM processes are active and changing in their nature during different parts of even the most simple group project. Our research indicates that the ICT technical infrastructure needs to support these necessarily shifting alignments between role, respect, purpose and the kinds of shared thinking and expert decision making that are needed, at any one time, to achieve practical outcomes. An effective STS also needs to be designed to facilitate, and make clear, shifts in leadership and authority according to the knowledge and capability of individuals and the changing demands of an activity.

The research reported here has been undertaken in communities either within learning institutions or in the broader arena of civil society. It is encouraging to know that there is complementary research (AA 1999, Warne et al 2003, Lock Lee & Neff 2003), which is pointing to the fact that communities are good government and business investments, even if their value cannot be measured or even anticipated when they are formed. These new forms of KM are challenging the current focus of management on profitability and shareholder values, and may be seen as leading to long term sustainability. Advice from the Author Andersen business report (AA 1999) to those who want communities that are focused and appropriate for a business, is to lighten up and stop trying so hard. That is, trusting relationships and team confidence, within a group, only emerge where people are valued and respected for their capabilities and clear about their mandate to act creatively. Managers should trust that members of communities are professionals and adults who are aware of the main purpose of the online communities to attain business goals. In particular, they need to value social interaction and non-business exchanges as these occur between individuals, as these may be the glue that holds the community together and an indication of increasing trust between members.

The fact that communities are being recognised as a source of business value indicates that research into the role of socio-technical models of communities in general is warranted. It appears that such communities have similar behaviours and concerns to those in the regional centres of our study. Self-sustaining communities require systems that support genuine knowledge creation and innovation by increasing an individual, or group's, capacity to take effective action. The message is that any technology used for activities of knowledge mobilisation at the level of the group or community should be developed, not on its own, but as a component of a broad socio-technical system. As stated above, Coakes (2002) describes the goal of socio-technical design as to produce systems capable of self-modification, of adapting to change and of making the most of the creative

capacity of the individual for the benefit of the organisation. Our research demonstrates that this may best be done in communities that are located between the level of individual and that of the whole organisation.

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