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Keywords
Virtual Space, collaborative activities, socio-technical systems

Disciplines
Business | Social and Behavioral Sciences

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The Co-evolution of an Accessible but Secure Virtual Space for Collaborative Activities

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Abstract
This paper describes, analyses and interprets a research and development process taking place over several years concerning the evolution of a socio-technical system. By 'socio-technical system' we mean a dynamic system that is socio-culturally situated and involves both human activity and technical elements. The system design, that is the focus of this research, brings together the human and technical dynamics of the intricate and highly engaging processes of effective collaboration. In particular, an investigation of the various integrated elements of the socio-technical system has provide us with the insight and confidence to build a virtual environment that actually supports innovative collaborative activities

1 Introduction

There are many forms of social organization that form the contexts for individual and group activity and shape the needs and purposes of those involved. With regard to the complex global socio-technical systems of the twenty first century, innovation and emerging changes tax the capabilities of many organisations and communities that have evolved in more stable and geographically insulated times. In a keynote address to the Global Forum of the Society for Organisational Learning, Alain de Vulpian examined humanity's on-going process of civilisation and described the anthropo-sociological transformation that we are now living through as follows:

> "We are in the process of moving from a pyramidal, hierarchical society to a single-story society where heterarchical relationships dominate. (*In such a society)* an effective leadership is in particular linked to an ability to sense and understand the latencies and natural dynamics of the surrounding socio-system and to catalyse them positively" (De Vulpian 2005).

New capacities to choose, to empathize with others, to see the collective source of what is happening, and be agile in the face of change now provide increasingly strategic and economic benefits for individuals, organizations and communities. New technical systems are needed to serve people as they navigate *together* through complex situations. Secure virtual spaces now make it more feasible to experiment, explore, prototype, experience and modify shared ideas and emerging

actions – to allow natural leadership to emerge according to the demands of the situation.

In this context, this paper describes, analyses and interprets a research and development process taking place over several years of the evolution of a particular socio-technical system. The focus of the investigation was on:

- **Co-evolution of an evolving socio-technical system,** with notions of participatory design, evolutionary prototyping, advancing the human\social with the technical,
- **Accessibility** including aspects of ease of use, flexibility, integration, and adaptability of technologically based systems
- **Providing a Secure Social Environment** that is accessible only to active members of the working group, a safe and empathetic place to enter, where there is respect for individual skills, capabilities and needs, i.e. a *netiquette* prevails
- **Providing and Supporting a Virtual Space** for quality interaction and connectedness

This project has, at all levels been an experience of cooperative activity in building and designing the system. The iterative design has also reflected experiences of working closely with people engaged in meaningful cooperative projects. In our research we have investigated, through close observation, interviews and analysis of data, the human dynamics of the intricate and highly engaging processes of effective collaboration. Our investigation, and emerging understanding, of the dynamics of the social elements of the socio-technical system has provided us with the insight and confidence to build a virtual environment that actually supports such activities.

2 Background

Accessible virtual spaces for communities should always be viewed holistically as socio-technical in essence. So often the social processes and the human-computer interaction are not incorporated into the system specifications or design. It seems that some of these *softer* parts of the system are difficult or even impossible to *design* in the traditional sense of the term. In a dynamic socio-technical system, the design of the system emerges over time as an outcome of pressures from social needs and capabilities, the emerging activities that are supported by the system, and the technical affordances offered by the system. Traditionally systems have been designed by technical developers for users. For us, *participant design* has come to mean additional ongoing participation by users in elements of the design of the system to meet their needs. A basic premise of this paper is that systems are essentially socio-technical in nature and should be viewed from this perspective in any comprehensive discussion.

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 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 support the notion that, from this perspective, the applicability of socio-technical principles and the methods of application associated with them help organisations to explore conflicts and complexity in the human, organisational and technical aspects of change (Coakes 2002).

3 Research Approach and Method

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 that tests knowledge against standardised criteria and 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 the 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 designed and constructed using an understanding of the dynamics of the human activities that will be facilitated by the system, it is used with the target group, and then the resulting activity is analysed through participatory observation before the prototype (both technology and social system) is revised (Preece et al 2002).

This approach is influenced by the expanding spiral of learning in the developmental work research (DWR) approach (Engeström 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 involving the emergence of a socio-technical system that supports knowledge mobilisation in communities.

The evolutionary research process has been guided by the model depicted in Figure 1. 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 and development. Much of the research output is realised in the conceptualisation and design of subsequent versions of the socio-technical system and so the emerging system itself, and the record of human activity within it, constitute the 'data display" component of the model in Figure 1.

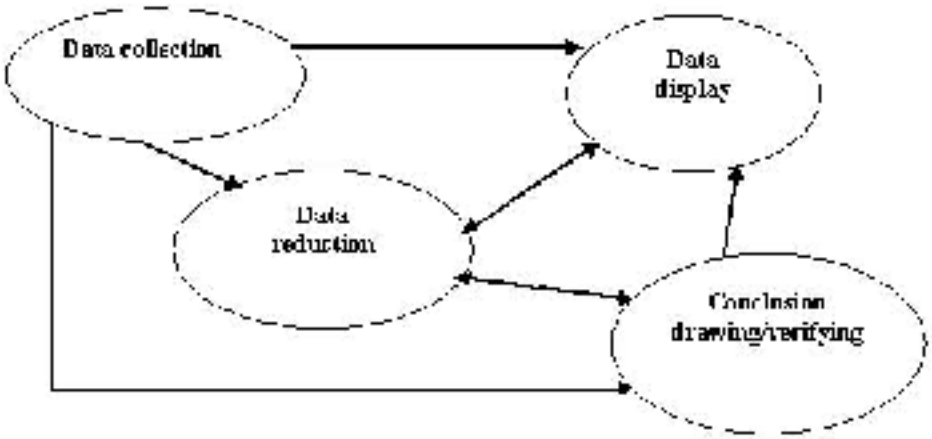

Figure 1: The iterative qualitative data analysis model (Miles & Huberman 1994 p12)

4 The Socio-Technical System: a tool for community communication and collaboration

The long-term research activity has been an integral component of the developmental approach to the social and technical support for work and learning in diverse communities. The concept of community has undergone considerable re-evaluation in the changing world described at the beginning of the paper. The work of Jack Carroll in the Blacksburg Village project (Carroll & Rosson 1996) and Bonnie Nardi in her work with the Disney Corporation (Nardi & O'Day 1999) is evidence of the changing urban landscape which has seen the disappearance of traditional face-to-face neighbourhood communities and the emergence of many communities of interest and practice in the online environment. However the

digital divide has resulted in whole sections of society where neighbourhood support groups have disappeared and where disadvantaged groups of society have limited access to their replacements on the Internet.

Our research approaches these changes as involving both social and technical issues. Indeed, the inexorable interconnection of both aspects in a socio-technical system is a central challenge of our work. The provision of suitable affordable technology is important but so are human issues of computer literacy, Internet accessibility and the ability to act cooperatively. Even more significant is the understanding of how to participate in a community where much activity is conducted in a virtual space. A technical tool, Eviva[1] has evolved throughout the research to support the purposeful activities of a wide variety of communities. During this evolution much learning has taken place among the members of the communities and the researchers. 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. More detailed results and implications of these requirements will be presented later in the paper, including the creation of appropriate protocols, processes and guidelines to surround and support the communities particularly in the virtual space.

To begin, however, we now reflect on earlier stages of this work, which have been reported elsewhere (Hasan & Crawford 2003a, b). The research was inspired by an exercise in experiential, team-based learning, that had been successful in creating awareness of the new science of Photonics among communities of high school student and teachers in a large city. In the initial Photonics project, scientists, business developers, teachers, technologists and business people contributed to workshops, online exchanges and a shared project to raise public awareness and present information about the emerging scientific field, and related industrial applications, to members of the community.

In these projects, subject-matter experts, students, teachers, parents, 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 the new technologies.
- 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. As presented above, the model begins with a face-

1 Early forms of the system were called Unilinks and are referred to as such in earlier publications The system is now called Eviva. See: www.eviva.com.au

to-face workshop followed by a period online where learners, experts and instructors are linked and supported by the communication facilities and the secure collaborative spaces in the Eviva tool. During this period the community of workers and learners undertake a self selected and meaningful team-based, problem-solving project where experiential learning takes place through the generation of skills, ideas and solutions. Subsequent face-to-face meetings were found to be essential to celebrate achievement and sustain relationships among the community members.

This program of experiences was encapsulated in an emerging socio-technical model for online communities which 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 facilities. During this period the community of learners undertake a team-based, problem-solving project where experiential learning takes place through the generation of skills, ideas and solutions. The needs of such communites and the dynamics of their interaction informed the design of **Eviva 1**

Following the research methodology described in Section 3 of the paper, development research investigation has been conducted using this model in over a period of 4 years. In two regionally based communities, research was undertaken to evaluate the contributions of a socio-technical model of conduct and related interactive processes to the achievements of the community. A single day workshop was held to establish and build the community and to determine what would be achieved and how. The prototype of an online support system was constructed modelled on the one used in the previous Photonics National Project to stimulate web-based interaction between students and researchers to develop a public awareness program and related materials. Teams were established, and each team made a commitment to work together for an extended period online on appropriate project designed to facilitate the desired learning. Teams worked on-line and self managed occasional meetings to develop their projects, consult with experts, negotiate the terms of engagement for participation, and prepare their presentations. Information about the resulting projects was presented by each team at a concluding half-day celebratory meeting.

A new software prototype, incorporating enhanced features for usability, security and, performance, was built with a more skilful development team than the previous one, who could continue with the development during the research. This package provided 4 levels of participation from super-user to guests and enabled the establishment of many communities within which there can be many projects and each with multiple teams assigned to them. Each working space in the system had the functions of News, Forums for discussion, Storage of documents and Polling. There was also a messaging system and most parts of the system were customisable. Anyone could register into the system but, as a security measure, each person had to be accepted and assigned to communities, projects and teams by a super-user. This stage of the research involved an existing community, a group of regional coordinators of CTCs (Communities Technology Centres) a government funded initiative to provide IT services and training in small towns. This group, many of whom did not know one another, met at a two-day workshop where the researchers introduced the notion that they were a community with

common interests, problems and goals and that they could build a community of support, which could continue online, using the software.

5 Research Findings encapsulated in the design of Eviva

Eviva is a web-based system that has been designed as a shared virtual space that enables collaboration, co-evolution, co-invention, and communication. Its design reflects and incorporates the findings of our research that has been conducted on communities using Eviva as it has gone through an evolutionary development process.

An emerging factor from this research has been the importance of private work spaces for teams doing creative work. High risk experimental and creative problem solving is not done well in a public arena. Even in list serves used to share ideas the participation rate in such communities is low. For example, a knowledge management list serve moderator reported that 90% of the contributions came from 2.5% of the community (Timbrell et al 2005) Throwing pebbles into a dark Cave: a study of participation and behaviours in the only act-km online community, a presentation at the *ActKM Conference*, Canberra, October2005. In the Eviva System, small groups can work and use their own private set of tools for communication and coordination of projects.

The software package provides four levels of participation from *super-user* to *guests* and enables the establishment, by users, of many communities within which there can be many projects. Teams can be assigned to projects. In the system, the community work spaces represent relatively autonomous units, that can be independently administered, managed and modified, whereas the team spaces represent sub-groups of people in a community working together and the project spaces their areas of work. Sometimes a project space may become the joint work space for more than one team. As can be seen (Figure 2), teams can belong to more than one project and any project can involve more than one team.

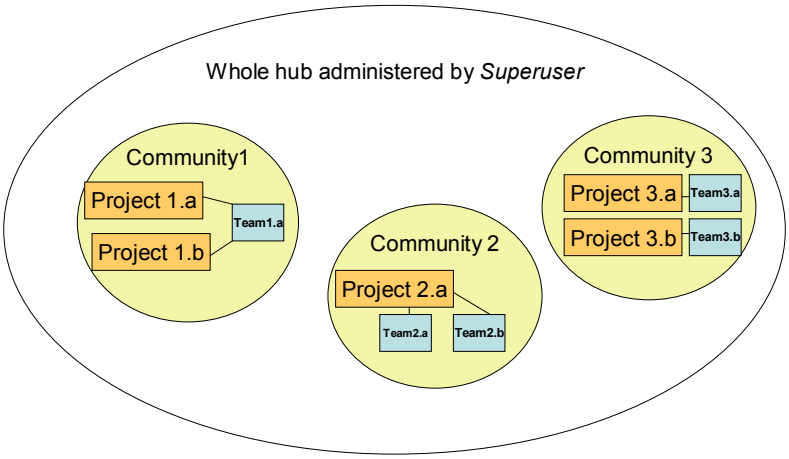

Figure 2: Relationships between system administration, community administration, project and team work spaces in the emerging Eviva system.

5.1 Functions, resources and the authority to use them

Each community, project or team space within the web based system has its own functions of News, Forums and Chat for discussion, Storage of documents or files and Polling. Levels of user authority can be easily varied at will by users with administrative authority in each space. The emerging pattern of use by many groups is for a single coordinator to administer the *community* space, project leaders to coordinate the *project* space and for a flatter structure where all members of teams have authority to use the full functions of the system in the *team* spaces. There is also a more private messaging system. The serious activity within the virtual work space generally occurs in small groups at the *team* level, rather than in the larger group spaces at *community* level.

5.2 Minimum requirements for specialist IT support

Many communities have little or no IT support so a system is needed that can be used and modified by ordinary people without IT specialist support. The system is designed so that people, with Superuser authority can easily create communities, special purpose project spaces, working teams of people, and link these together. Thus coordination and facilitation of multiple teams is facilitated in these flexible yet secure community spaces.

5.3 Ownership and appropriation of working spaces

Semi structured interviews with early participants in projects using the system consistently found that users responded well to being given a sense of authority and ownership of the problem solutions and that capabilities to appropriate virtual working spaces and modify them were an important aspect of the virtual context. These needs are important for individuals but are especially important for the development and maintenance of teams. Many parts of the system are customisable. Each individual has a *home page* where it is possible to incorporate personal information about interests, skills and capabilities in graphic and text form. Individuals can also incorporate a graphic signature icon as a part of their virtual persona. *Community*, *project* and *team* work spaces can be edited to provide information or to establish the rules of engagement within a community by people with administrative rights at that level. Thus, once they are set up, community spaces can be managed independently. In each space it is also easy to customise the look and feel of the system. These very tangible ways to appropriate the work spaces are highly valued both by younger users and also organizations seeking to extend traditional web based information sites with opportunities for quality interaction between staff or with clients.

Anyone can register in communities but must be accepted by the person with administrative responsibility in the community or by a *Superuser*, with overview of the system, and can be easily assigned to projects and teams. The social aspects of the system include ways to sustain and develop each group of people as a creative and growing community with devolved leadership and independence. The technical system is also designed to enable rapid updating of structure, content, and relationships as activities change or are completed. We have concluded that this aspect of the system facilitates more creative and shorter term activities as well as supporting more stable ongoing routines. Communities using the Eviva System 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 by leaders within the group. There is a need to recognise when a community is no longer functioning effectively and should terminate. Eviva has provision for archiving obsolete community activity and the related data.

Screen shots of Eviva in three stages of its evolution are shown in Figures 3--5

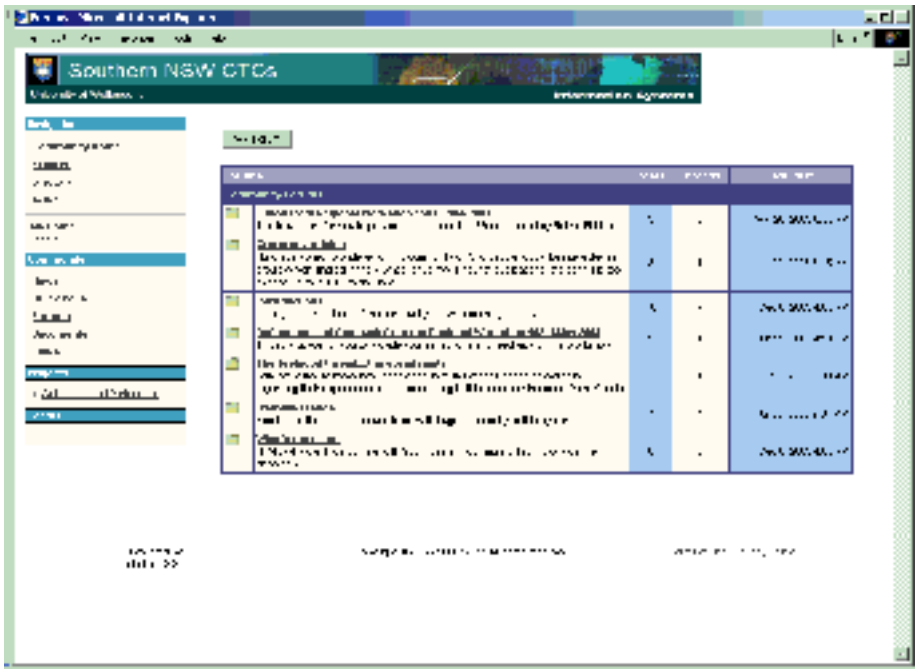

Figure 3: A community forum in an early version of Eviva –UniLinks. This was one of the first features to be implemented and follows research into asynchronous communication.

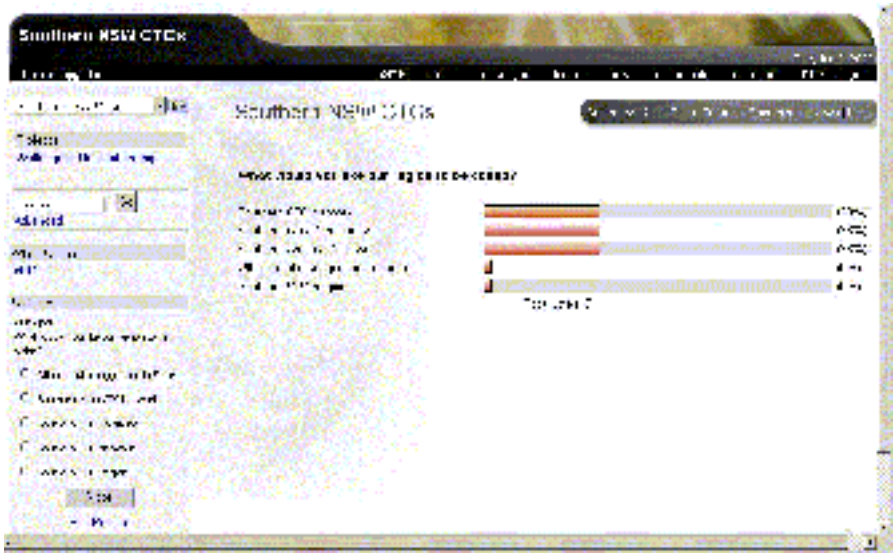

Figure 4: A polling facility was introduced in subsequent versions and proved to be most popular for a variety of uses and supported a democratic approach to the running of communities.

Figure 5: The home of a superuser in the current form of Eviva

Eviva is designed as a virtual, low risk environment that extends opportunities for:

- Mature and holistic management and coordination support for complex processes and autonomous groups
- Global connections and mentoring across traditional boundaries
- Connected shared spaces for quality interaction to evolve shared sense making, quality decisions and creative emerging outcomes
- Agility in the face of changing circumstances and emerging opportunities
- Connections across boundaries for skilled collaborative work and sharing of diverse perspectives, sense making and intentions
- Low cost development and extension with stakeholder communities
- A reviewable record of all activity and records/files within the system
- Broader issues for the socio-technical system of communities using Eviva

5.4 Feedback and Integration

An emerging issue for the research is the need to provide positive support and reinforcement for shared behaviour. This requires people to become aware of the activity of others in the system. The system now collects and visually represents cumulative information about an individual's level of participation in shared activity and development of the virtual environment. The generic results of polling are also available to all members of the work space where the poll is conducted. Most work places use email extensively and the virtual work space is

a new idea for many. Information about activity is also summarised and emailed to participants on request with a prompt to log into the site.

5.5 Broader issues for the socio-technical system of communities using Eviva

The system has been designed with a focus on the needs of people who are highly engaged in shared actions and need a flexible environment they can shape to meet their needs and use to keep a record of their evolving intentions and decisions. As discussed above, the system has evolved to support:

- Easy appropriation and customization of work spaces and flexible management of access privileges
- Privacy for quality interaction in teams 'privacy is good'
- Distributed leadership throughout community groups
- Feedback about community activity to members (E.g. quick poll results, information about levels of community participation)
- Resources in work spaces are stored and permanently accessible and replicable to members – always available and replaceable
- Negotiated rights of access and utility – flexible and action based
- Connections between sectors – sub groups within a community can engage in specialist purposes and projects
- Exchanges of goods (e.g. software programs, video clips, work experience on-line) as well as ideas and advice
- Integrated email activity reports to notify members of any news or changes in their communities.

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:

- How much intervention should be made by the community sponsor or leader to sustain initial enthusiasm, promote activity or control inappropriate behaviour?
- What skills and experience are essential and desirable in selecting and preparing people for membership of a community?
- How can community value be established in order to justify costs?
- Whether there is a need to classify different types of communities.
- Are, networked online communities different from traditional ones and if so in what ways?
- In what contexts are separate, closed systems for community support, where users must go to the effort of a login to participate, more suitable than more open environments, such their normal email system, through which they communicate to everyone else?

The Eviva System is an accessible virtual space for quality interaction. Our research suggests that quality interaction involves at least three kinds of activity. These are:

- Conversations and negotiations to form a shared understanding of the group members, the relationships between them, the community rules of engagement, and the expectations for each individual

- Exchanges of materials, information and expertise to facilitate the project
- Collaborative activity where people work together to achieve a shared goal

The system is designed as a virtual extension to other emerging learning architectures in communities and organizations. The web based system is designed to facilitate team work and connections between people, information and shared actions across cultural, professional and geographic boundaries. It also helps people to overview emerging developments among more autonomous teams and expert groups without reducing the confidence and authority of the group. The virtual work spaces can be customized by working communities in ways that enable particular projects and allow people to consciously create desired patterns of connectedness and shared interaction. They can also customise the look and feel of community, team and personal spaces. This design feature points to one of the reasons Eviva is so easy to use. If people construct their own community environment and specify the way it will work, they can understand the structure and use it easily for their purposes. Non IT specialists can also create or archive project and team work spaces for sub-groups within their communities. Each of these spaces is resourced with tools to support interaction and shared work in much the same way as houses in a modern city are supplied with water and electricity.

6 Responding to Research on Emerging Social Interaction Patterns

Emerging heterarchic and networked social structures of social interaction and creative activity are emerging as a part of the digital civil culture. They connect people across traditional boundaries as predicted by early technical innovators.

> 'Networks and cyberspace communities connect players in different sectors much as transportation systems and cities on the ground have always done' (Mitchell 1997).

These new connections provide very fertile ground for adaptation, innovation and creative new solutions to entrenched problems. However, our research suggests that organizational structures and processes are slower to change. Recent research (Warne et al 2005) investigating network centric warfare, involving groups of people in rapidly changing situations, indicates that the quality of interactions and relationships between people is of central importance for effective operational outcomes. The emerging software design is a response to the expressed needs of people at all levels. In particular, the emerging system supports more mature and holistic management with an effective overview for coordination support of complex processes and autonomous working groups. The further development of this aspect will be a key issue for our work in the future.The system allows groups to easily co-opt experts and receive advice, mentoring and support across traditional boundaries and in ways that are less time consuming and more efficient. This feature is an important need of emerging stakeholder communities in innovative projects. Expert advice, once given in a document or a forum discussion, remains available to the whole group for the duration of the project. The system is designed to be easily and rapidly modified, by anyone with basic office computer skills, and thus makes it possible for people to work agilely and to up date the arrangements and site structure , without costly IT support, and thus to maintain a work space that continuously reflects the changing program of

activities. Finally, the system provides a continuous record of all the activities and records/files within the system. Community work spaces can be easily archived for later reference when no longer needed.

People who are highly engaged in shared actions need a flexible environment that they can shape to meet their needs and use to keep a record of their evolving intentions and decisions. Easy appropriation and customization of all work spaces and flexible management of access privileges makes it possible for sub groups to manage themselves independently while the system potentially provides a record of all activities that can easily be accessed and overviewed. Achieving the balance between overview and privacy for distributed community leadership and for small expert teams to work creatively and intensely together has been an achievement of the system development and continues as a central issue for future functionality. Collaboration depends on effective communication, shared knowledge and coordinated action within a group. Within each workspace possibilities for immediate feedback about ideas or emerging prototypes are important and now include chat facilities, links between forums and uploaded documents for easy discussions within a group, quick polls for easy surveys opinions or progress with results published to all group members. The system is J2EE compliant and file handling facility make it easy to store and exchange goods (E.g. Video clips or software programs), as well as ideas between group or community members.

7 Conclusion

We must be the change we seek to create.2

The most important thing learned from the project that has been reported here, is that only experience of cooperative activities and working closely with other people engaged in meaningful cooperative projects provides the insight and confidence to build an environment that actually support such activities. In the culture of many organizations, people have struggled to even imagine working in this way. In contrast young people working in our projects find the system very easy to use and enjoy it. Other research (E.g. de Vulpian 2005) indicates that experience of participation in the civil society and in particular the evolving digital culture has increased these skills among many young people. However, for many other people cooperative activities in virtual spaces are only just beginning. However, allowing people to actively participate in the evolving design of their virtual work space appears to provide a new opportunity for people to develop capabilities for shared learning and work. Also, the possibility of a less intrusive overview of more independent activity, through more tangible evidence of previously tacit activity available in the Eviva system provides reassurance for leaders and managers seeking to catalyse positive dynamics in a system designed for more flexible and creative work. It seems likely that such capabilities and expectations will grow and change. Thus we are certain that the design of systems such as Eviva will need to be modified, on an ongoing basis, if they are to continue to reflect the evolving societal practices and needs of the people who use them.

2 Mahatma Gandi, cited in Presense, P. Senge et Al, MIT press 2004, p151

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