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The sensible organization: a new agenda for IS research

Helen M. Hasan

University of Wollongong, hasan@uow.edu.au

L. Warne

Defence Scientific and Technical Organisation

H. Linger

Monash University

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THE SENSIBLE ORGANIZATION: A NEW AGENDA FOR IS RESEARCH

Helen Hasan

University of Wollongong
Wollongong, NSW 2522, Australia
hasan@uow.edu.au

Leoni Warne

Defence Scientific and Technical Organisation
Canberra, ACT 2600, Australia
Leoni.Warne@dsto.defence.gov.au

Henry Linger

Monash University
Melbourne, Vic 3800, Australia
Henry.Linger@infotech.monash.edu.au

Abstract

IS research and practice does not adequately address modern organizational forms of flatter hierarchies; decentralized decision-making, greater capacity for tolerance of ambiguity, permeable internal and external boundaries, capacity for renewal, self-organizing units, self-integrating coordination mechanisms and continual change. The important challenge for IS is to determine what sort of organizational forms, structures and systems are most appropriate to meet the demands of the current and foreseeable environment. We argue that this challenge can be met through a new agenda for IS based on the concept of the 'sensible organization'. Our argument is grounded in evidence drawn from the findings of a number of our empirical studies. We conclude that the new agenda for IS needs to target the agile, social and networked organization, in the context of its chaotic, complex environment, in order to support knowledge work practices that integrate thinking and doing.

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Introduction

Is IS research and practice keeping up with modern organizational paradigms? The defining characteristics of modern organizational forms are purported to be flatter hierarchies; decentralized decision-making; greater capacity for tolerance of ambiguity; permeable internal and external boundaries; capacity for renewal; self-organizing units, self-integrating coordination mechanisms and continual change (Daft & Lewin, 1993; Warne et al., 2004). In such organizations, information and particularly knowledge is acknowledged to be the most strategically important resource. Yet, many systems that are developed to support organizational activities continue to fail at an alarming rate (Hart & Warne, 2005; Warne, 2002). Information systems success and failure have been much discussed in the literature for many years, and many authors have posited structural, cultural and social reasons for such failures (e.g. DeLone & McLean, 1992; Fortune & Peters, 2005; Lyytinen & Hirschheim, 1987; Sauer, 1993; Warne, 2002). This paper argues that the modern paradigm for organizations begs a new agenda for IS research and development, and we do this by introducing the concept of the ‘sensible organization’.

There are many things about work in today’s organizations that just don’t make sense, particularly in IS terms. We observe contradictions, stresses and tensions everywhere, exemplified in the following questions:

- Why are we working so hard when IT once promised to give us so much extra leisure time?
- With digital storage so cheap, abundant and flexible what happened to the promise of the Paperless Office?
- With all the functionality, connectivity and easy access to information provided by the Internet why have we been surprised by the resulting “influenza” and have not learnt to cope better with information overload?
- Why organizations so often are locked in and constrained by rigid legacy systems/ERPs when modern information and communications technology (ICT) applications used in the civil, digital society are so flexible, adaptable and enabling of such creativity?
- Why do large business, government and military enterprises struggle to promote a cooperative and supportive corporate culture despite their stated aims to become innovative ‘learning organizations’ and despite the new ‘social technologies’ available to them?
- Why is it so difficult to acknowledge the hidden informal side of organizations by trusting, empowering and rewarding teams of networked knowledge workers to take risks, be creative and lead the enterprise’s performance into the future?

In this paper we propose that one of the most important challenges for IS research is to determine what sort of sensible organizational forms, structures and systems are most appropriate for the current and foreseeable environment. We will use the findings of our empirical research, and that of others, to provide evidence to support this proposal arguing that the IS agenda should

- learn from mistakes of the past where many IS project have assumed an outmoded organizational context of operation,
- observe, and make sense of, current IS trends, particularly in the use of the relatively new social technologies
- use our knowledge as IS experts to anticipate, and prepare for, future possibilities.

Sensible Organization

The concept of a ‘sensible organization’ is related to the sense-making view of organizations (see eg Weick, 1995; Wiley, 1994; Cecez-Kecmanovic & Jerram, 2002). Linger and Warne (2001) distinguish three significant levels of sense-making: individual, organization, and an intermediate level (the team/group/unit) which is the seat of most innovation and creativity in organizations. It is within these social entities, at the intermediate level, where the challenges and potential of a sense-making approach are most apparent. Underpinned by social technologies, sensible organizations can encourage the emergence of self-directed teams interconnected in a network-centric configuration as described in Warne et al (2005c). The informality, interactivity and adaptability of small teams of people retains a space for what we traditionally call ‘common sense’ for both understanding and action amid the

accountability and constraints of the formal enterprise. So what we propose is not new but a return to past skills that may have been lost in the sophistication of the modern workplace incurred by the speed of ICT-driven change.

The significance of ICT that could support the less formal, social aspect of teamwork has long been a focus of the field of Computer Supported Cooperative Work (CSCW). Back in the early 1990s Bannon (1992) saw CSCW as a new research field involved in exploring a wide range of issues concerning cooperative work arrangements and its support via information technology. Bannon goes on to say that while fields such as social psychology have concentrated empirical research efforts on artificially created 'groups', in CSCW, researchers undertake more qualitative, interpretive, and ethnographic studies of cooperative work arrangements that emerge as a result of the nature of the actual work being performed. In a return to these roots, the 2007 European CSCW conference is holding a workshop to re-evaluate the focus of CSCW in light of media attention on the new 'hot topic' of Web 2.0, noting that most Web 2.0 or social software applications e.g. Wikis and Blogs, are cooperation support applications (Prinz & Kock, 2007). The workshop overview states that the Web 2.0 and social software fields could benefit from applying CSCW research results to their work and vice versa. This is especially true since the social software field is currently extending its application area to supporting teams in companies ('Enterprise 2.0'). The workshop organizers claim that "most of what currently is advertised as a revolution on the Web has been there as CSCW applications years ago however, not as nice and not as usable as today in the Web 2.0" (Prinz & Kock, 2007). This implies that, with new social technologies used appropriately in organizations, some of the original promise of ICT may be sensibly fulfilled.

The sensible organization needs to be understood in the context of its structural and functional form, and the interdependencies between these, in shaping the organization. In the face of the increased complexity and rate of change in the social and commercial context of their operations, sensible organizations are changing in order to maintain a strategic and sustainable position in the broader society. The emerging flatter forms of modern organizations call for substantial changes in the ways people work so as to support agile team work and well coordinated group activity that is flexible but also well aligned with desired operational outcomes. As a consequence, many organizations are adopting a type of network-centric configuration in which workers leverage information through the collaborative efforts of small and agile self-directed teams (Warne et al., 2005a,c). This view of the network-centric environment implies new structural forms and new ways of working, with consequences for the organization's infrastructure, processes, people and culture.

Managing organizational transformation towards a more responsive network-centric form is both difficult and complex but we argue that it makes sense in the current and foreseeable future environments. In our research, some of which will be described later in the paper, we have observed that attempts to deal with complexity are unsuccessful if they aim to either simplify or assert control over complex situations. We contend that it makes more sense to maintain and support the creative energies of complex environments, encouraging the emergence of innovative new forms of working. A multi-perspective, multi-disciplinary approach is needed to make sense of today's world where holistic systems thinking, together with theories of complexity and chaos, have become popular in many areas of both the natural and social sciences. Notions of complexity and chaos reflect the tension between the natural tendency for disorder to increase while humans strive to impose order by developing ever more complex systems. History tells us that self-organizing structures of more numerous smaller elements are more likely to result in a complex but stable system than ones dominated by smaller numbers of larger and more highly controlled units (Sterman, 2000). The latter are likely to be exploitative and bureaucratic while the former can be networked and innovative.

Many large businesses and government organizations, faced with the pressures of an ever-changing environment, are becoming envious of flexible and adaptable community networks. These organizations are endeavoring to become more network-centric through the establishment of agile teams, self-directed workgroups and communities of practice (see e.g. Peltokorpi and Tsuyuki, 2006). Stuck between bureaucratic rigidities and international competition in global markets, organizations have had to reinvent their competitive advantage by introducing, or reintroducing some form of cooperation within and between their internal boundaries (Josserand, 2004). Of immediate relevance to IS research is recognition that the future may lie in blurring the distinction between organizational information systems and those used in civil society. This includes corporate appropriation of applications such as Wikis (Pfaff & Hasan, 2006) and collection of other web-based tools (see for example Hasan, 2006a) that empower knowledge workers and democratize organizational information. IS research will need to increase our understanding of these transformed organizational cultures in order to provide advice on managing organizations where uncertainty and complexity are the norm.

The Context for Sensible Organization

The Attributes of Complex Environments and Its Implication for IS

We currently dwell in a turbulent environment, in which change constantly occurs and elements in the environment are increasingly interrelated (Robbins, 1990). During the latter part of the past century, the nature of change is frequently revolutionary rather than evolutionary. The progress in ICT and the inception of the Internet as a global computer network have made the world more interconnected in a manner that has never existed before in the history of mankind and this acts as a catalyst in fostering further change. As a consequence, we can expect that transformational change is a common theme rather than an exception. The implication of this phenomenon poses an immense challenge to IS academics and practitioners alike to successfully understand and manage organizations as complex entities supported by multiple interacting information systems. Senge (1994) makes a case for Systems Thinking as the discipline that gives us a holistic way of understanding the emerging patterns in this complex world. He writes; “from a very early age, we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable, but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole” (Senge, 1994, p3).

In the context of the sensible organization a complex system is any system which involves a number of elements, arranged in structure(s) which go through processes of change that are not describable by a single rule nor are reducible to only one level of explanation; these structures often include features whose emergence cannot be predicted from their current specifications (Hasan, 2006b). Complex systems theory also includes the study of the interactions of the many parts of the system (Sterman, 2000). Previously, when studying a subject, researchers tended to use a reductionist approach that attempted to summarize the dynamics, processes, and change that occurred in terms of the lowest common denominators and the simplest, yet most widely provable, applicable and elegant explanations. This does not suit the field of IS, which intrinsically takes a socio-technical system’s view of the situations it investigates. A powerful illustration of this in IS is reflected in the Soft Systems Methodology (SSM) developed by Checkland (1991) from his experience as a consultant on real-world problems. SSM is based upon systems theory in sharp contrast to conventional, 'reductionist' scientific enquiry. The seven stages of SSM begin with the drawing of a ‘rich-picture’ to capture the complexities of a situation and to be a means of communicating with non-technical clients. Since the advent of powerful computers, which can handle huge amounts and variety of content, researchers can study the complexity of factors involved in a subject and see what insights that complexity yields without simplification or reduction. Complexity itself is characterized by a number of important characteristics such as self-organization, non-linearity and emergence (Snowden, 2002).

To make sense of a complex system one needs an understanding that accommodates its inherent dynamics and includes the ability to incorporate unanticipated and unforeseen features. This requires a meta-level situated understanding of the complex system in order to instantiate the system at any point in time and provide a longitudinal understanding of the changes to the organization over time and the possibilities open to the organization in the future. Snowden’s Cynefin model, depicted in Figure 1 (Snowden, 2002), provides a framework for such understanding. Snowden’s perceptions of the characteristics of self-determination, emergence and organic forms that apply in the Complex quadrant are of particular interest here.

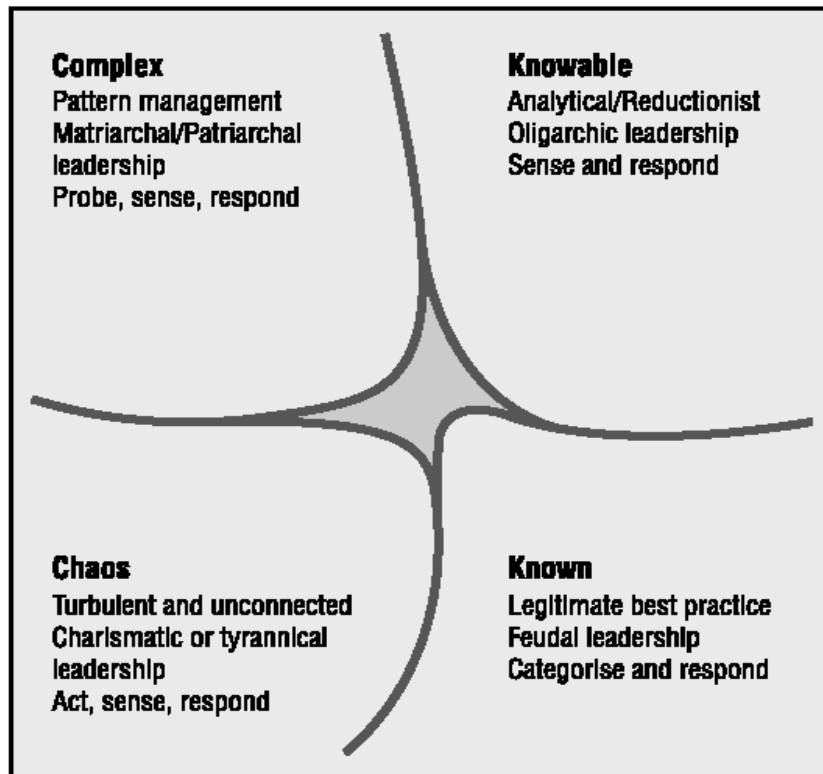


Figure 1 The four perspectives on organizations, knowledge management and information systems depicted in the Cynefin framework (adapted from Snowden, 2002).

There is a current interest and growing understanding of how to work with complex systems where it is not possible to predict or determine outcomes in advance, and how meaningful patterns of behavior emerge that can be encouraged, but not mandated or controlled. According to Snowden (2002), attractors and barriers can be used to enhance the likelihood of desirable outcomes, and indeed innovation and organizational learning. Rather than implying that chaos is the natural outcome of the self-organizing capabilities of informal communities, Snowden has faith in the human capability to create order and predictability through collective and individual acts of freewill. His Cynefin model (Figure 1) is a knowledge space with four domains that set the context for collective decision making: two domains of order, the known and the knowable, and two domains of disorder, complexity and chaos. Each has a different mode of community behavior and each implies a different form of management and a different leadership style with the adoption of different tools, practices and conceptual understanding.

Sensible assumptions about most modern organizations are that they have complex hybrid structures consisting of hierarchies and networks and that they are often more like eco-systems than machines. Using the Cynefin model one is able to see how organizations and their information systems can be part mechanistic and part organic, realizing that organizational transformations are, and will, continue among these forms. Moreover it makes sense to adopt the position that this is now a natural state of affairs and not to be resisted. Indeed this creates an ideal context for innovation, creativity and growth; a context in which rational planning should give way to processes which stimulate patterns of propitious emergent activity with an emphasis on sense-making, unstructured decision making and shared situation awareness. Contrast this with the large traditional body of IS which takes snapshots of organizations from a particular point of view. While much of this may have worth, it is not helpful in the environments we face.

To align IS research and development with the innovative, dynamic and emergent activities of organizational transformation, the dynamics of these activities and transformation processes needs to be reflected not only in the organizational systems being delivered but also in the research. Admittedly, taking organizational dynamics into account in IS research is difficult. It is often more time consuming, needs more complex approaches and techniques as well as more holistic theories and frameworks. Yet this is the essence of the contradiction and challenge for IS research and practice.

The Consequences of Information, ICT and Socio-Technical Systems

Looking back over the history of IS research and practice it can be seen that IS draws significance from the uniqueness of computer-based information and communication tools and their place in shaping recent human, social and organizational history. In complex environments, advances in the field of IS will result from a better understanding of how to develop and use these tools, how they are shaped by their use and what impact they have on the way we work and live. The rapid evolution of ICT is continuing to transform firms from relatively simple entities, with solid boundaries and formal hierarchical structures, into a much more complex interconnected set of internal and external relationships. However many of the anticipated benefits of ICT have not been realized, a reflection of the fact that, in a truly complex environment, patterns emerge that cannot be predicted.

Two of the consequences of the introduction of ICT that were largely unanticipated are ‘information overload’ and ‘the myth of the paperless office’. Now they are accepted as part of our working lives. Information technologies have advanced to the point where it is now possible to produce, manipulate and disseminate information ... much faster than we can process it” and “instead of better enabling a person to do their job [this] threatens to engulf his or her control over the situation” (Edmunds & Morris, 2000). This phenomenon is now well known as “information overload”. Other terms referring to the same thing are “infoglut” and “data smog” (Shenk, 1997), and the effect on those exposed and affected by it has been called “analysis paralysis” (Stanley & Clipsham, 1997) and “information fatigue syndrome” (Oppenheim, 1997).

Over the past thirty years, many people have proclaimed the imminent arrival of the paperless office yet paper continues to play an extraordinarily important, and perhaps even increasing, role in office life. It is calculated that the use of e-mail in an organization causes an average 40 percent increase in paper consumption and even the extensive use of the World Wide Web has increased the amount of printing done (Sellen & Harper, 2001). These authors suggest that, rather than pursue the ideal of the paperless office, we should work toward a future in which paper and electronic document tools work together in concert and organizational processes make optimal use of both.

The phenomena emerging from developments in ICT, such as ‘information overload’ and ‘the myth of the paperless office’, although the bane of our modern lives could be mere symptoms of deeper issues. It is our contention that less visible, but of greater impact than these well-known phenomena, is the reality that ICT/IS in organizations has taken away

- the routine parts of work and with them the time and place for reflection,
- the hands-on experience of work so that people loose touch with reality
- much of the face-to-face social interaction so that trust and understanding is diminished in communication
- recognition of the importance of, and support for, the invisible, pervasive, informal organization

We are encountering these issues and their consequences in our research and believe that herein lies one of the greatest challenges and opportunities for IS research.

The characteristic of IS that distinguishes it from other management fields in the social sciences is that it concerns the use of “artifacts in human-machine systems” (Gregor, 2002). Conversely the characteristic that distinguishes IS from more technical fields, such as Software Engineering, Computer Science and Information Technology, is its concern for the human elements in organizational and social systems. Most introductory textbooks describe the IS artifact as composed of a variety of component types: hardware, software, storage, processes and people. However in common usage some of these components, particular those made up of people or business processes are often not seen as part of an IS. Phrases such as “using the system”, and “putting data into the system” imply that the *system* is seen purely as a technical artefact. Both research and practice echo this perception so that often the business process and the human-computer interaction are not incorporated into the system specifications or design. It may be that some of these *softer* parts of the system are difficult or even impossible to *design* in the traditional sense of the term.

A basic premise of this paper is that all IS are essentially socio-technical in nature and continually evolve so that they acquire emergent properties, uses and impacts. 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 organizations. The term effectively expresses the intricate relationship between the social and technical elements of any IS. Taking into account the proprieties of complex environments, Coakes (2002) describes the goal of socio-technical design as producing 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 organization. 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 support the notion that socio-technical principles and their application help organizations to explore conflicts and complexity in the human, organizational and technical aspects of change (Coakes, 2002).

Case Studies from our Research

Our assertion to this point is that IS are socio-technical in nature and provide service to organizations which reside in a realm of complexity. It is not surprising that we did not anticipate many of the consequences of the systems we create, such as overworked employees, whose creativity is constrained by inflexible corporate systems and who are reluctant to cooperate in the culture of a learning organization. Our intention here is to describe and reinterpret those aspects of our research published over the past 8 years to draw informed lessons from the past and make reasonable sense of current IS trends in order to anticipate, and prepare for, a more sensible future.

This research has involved field studies of diverse organizations and used approaches, methods and theories that were at times developmental, interventionist and participatory involving action research arrangements and the collection, analysis and interpretation of qualitative data. These approaches have enabled us to retain the attributes of complexity, dynamics and change in our work by taking a holistic and systemic view, blending the social with the technical, providing and supporting a culture of learning, growing and adapting. Such research moves us from Mode 1 research where problems are set and solved in a context governed by the interests of a largely academic community to Mode 2 where knowledge production is carried out within the context of application as proposed by Gibbons et al (1994). The Mode 2 form of knowledge production is context-driven, problem-focused and interdisciplinary and, according to Gibbons et al, emerged in the mid 20th century when multidisciplinary teams were brought together for short periods of time to work on specific problems in the real world. Etzkowitz and Leydesdorff (2000 p116) support the distinction between the two modes of research but argue that the Mode 2 is the original format of science before its academic institutionalization in the 19th century as Mode 1. Mode 2 represents the material base of science, how it actually operates. Mode 1 is a construct, built upon that base in order to justify autonomy for science, especially in an earlier era when it was still a fragile institution and needed all the help it could get. Batterham (2003) describes Mode 1 as 'discipline based' and distinguishes between theoretical core and its conversion to application, while Mode 2 is "multidisciplinary, team based with a constant flow between basic and applied research so that discovery occurs where knowledge is developed and put to use".

In this paper our description of, and argument for, the 'sensible organization' is grounded in our empirical Mode 2 research and is enriched by our research findings, a summary of which is presented in this section. Our studies all focus on activities that are task-based, addressing the group level in organizations and are set within the context of a socio-technical system. These studies explore various factors that contribute to the creation of intellectual, social and emotional capital in enterprises and reinforce our position that most innovative work involving new knowledge creation takes place in small teams and groups. It also highlights that these social groupings need to be granted the capacity, authority, responsibility and recognition to undertake such innovation. Revealing the hidden nature of the informal parts of the organization contributes to the emergence of the sensible organization. Moreover it raises questions about the appropriate management of the sensible organization, and the nature of the socio-technical context including new ICT capability and the modern complex environments.

The following is the collection of inter-related research projects undertaken by the authors and the focus of each project.

1. **Social Learning in the ADO** – identified the significance of the human dimensions of even the most technical and bureaucratic of organizations
2. **Weather Forecasting** – demonstrated the importance of knowledge based work practices to sense-making at the intermediate, team-based level of organization
3. **The Photonics Project** – developed a multifaceted socio-technical model of heterogeneous teams working on projects supported by web-based technologies in a contemporary environment
4. **Developing Web Communities** – provides an understanding of voluntary cooperation and natural ways of working together in the modern Internet enabled world in the civil digital culture

5. **Perceptions of Middle East Warfighters** – develops a case for network-centrism highlighting the importance of networks in modern agile organizations and the need to understand the human side of the network-centric view of organizations
6. **Corporate Wikis** – Appropriating social technologies for business with a focus on the benefits and challenges of using social technologies from the civil digital culture to support social learning in corporations.
7. **Go*Team** – provides a simulated environment for understanding collaboration and training for Network-Centric Organizations

Social Learning in the Australian Defence Organisation (ADO)

This four-year research study investigated social learning within the Australian Defence Organisation (ADO) from 1998 to 2002. The immediate aim of this research was to investigate the issues inherent in building supportive procedures for adaptive and sustainable learning organizations. The long-term objective of the task was to develop social learning architectures that provide a means for depicting existing systems, a blueprint for the development of future systems, and a roadmap of how to get from one to the other.

For the purpose of this research, social learning was defined as learning occurring within a group, an organization, or any cultural cluster and included: the procedures by which knowledge and practice are transmitted across posting cycles, across different work situations and across time; and the procedures that facilitate generative learning – learning that enhances the enterprise’s ability to adjust to dynamic and unexpected situations and to react creatively to them. As the immediate aim of this research was to understand the issues inherent in learning organizations, social learning was tightly coupled to knowledge management.

Since the investigation necessitated a sound understanding of organizational culture, work practices, human social interactions, communication and relationships, the initial research methodology was appropriately based on ethnographic observations. However, the methodology evolved over time as the researchers moved from one case study setting to another. While the primary methodology in all phases of the study continued to be ethnographic, the research team also undertook extensive semi-structured interviews with a sample of staff and quantitative questionnaires were used to support and validate the qualitative data, as well as to facilitate comparison across the settings. The combination of qualitative and quantitative research methods provided data and findings that are much richer than those derived from one of these methods alone (Warne et al, 2005b).

An organization as large and diverse as the ADO is a complex and constantly changing entity, and the researchers were, therefore, working within the Complex domain of the Cynefin model, endeavoring to bring their findings into the Knowable sector. The findings of this research are therefore understandably complex, interdependent and interrelated, but the dominant finding was that it was the social aspects of organizational systems that were more important than the technical components in setting up and supporting a learning organization. The findings have been extensively published (e.g. Ali, 2002; Linger & Warne, 2001; Warne, 2000; Warne et al. 2003, 2005a). Foremost, the findings indicate that social learning is facilitated by a set of overarching organizational values expressed as:

- Empowerment (where empowerment of staff also makes them accountable);
- Trust (which entails mutual respect);
- Forgiveness (in terms of allowing personnel to take reasonable risks, forgiving mistakes and facilitating knowledge construction on the basis of lessons learnt);
- Cultural cohesiveness (in terms of common identity, shared goals and a shared understanding);
- Commitment (which includes a mutual commitment and loyalty between the employee and the organization)
- Openness of the decision making process
- A culture of information sharing.

Apart from the overriding set of values, we identified additional sets of factors that support and enable effective social learning. These factors fall into two categories. The first, Learning Capability, refers to characteristics in the environment and provides a context in which the second category operates. This second category is referred to as

Enablers and represents processes and strategies that, if present and effectively applied in an enterprise, can facilitate effective social learning and knowledge management.

Over the four year duration of the task, the research team made over one hundred verbal or written recommendations for improving social learning and knowledge management processes within the settings studied. A majority of these recommendations deal with the so-called 'people issues' as these issues were dominant in all the settings studied.

We firmly concluded that Information Systems and Knowledge Management technology will not effectively facilitate social learning or knowledge management in organizations until the cultural foundations are laid. This has enormous implications for how the IS industry defines, designs and develops supporting and sustaining systems.

Weather Forecasting as collaborative knowledge work

This was a collaborative project with the Australian Bureau of Meteorology (BoM) to improve meteorological services through the application of knowledge management principles to the forecast process.

BoM has a long history in using ICT, particularly for simulation modelling to generate the Numerical Weather Prediction (NWP) products that are based on numerical models of atmospheric science. ICT resources are also distributed into the forecast centres giving forecasters access to the NWP outputs and powerful tool such as data visualisation and graphical editors, historical forecast databases and automated forecast guidance. Despite pervasive technology in the workplace, forecasting remains a challenging task as forecasters must assimilate a vast amount of data, accommodate a great variety of information that is often incomplete and reconcile the NWP outputs with their experiential knowledge of the weather systems. Moreover the work must be done according to strict timelines and is overlaid by a legal regime (Linger & Burstein, 2001).

Our research focused on the forecast process and work practices in order to understand the forecasting task and make visible the processes that create and exploit knowledge. Our field studies in regional offices of BoM looked at how particular forecasts were constructed and inquired as to why particular actions and tool were used in that activity. Our analysis drew on concepts of sense-making (Weick, 1995) and inscriptions (Latour, 1990), in order to understand the cognitive and organizational processes that underlie the pragmatic performance of activities.

Importantly, our studies also analysed the interactions between the forecasters in order to provide further insights into underlying processes that forecasters employed in the construction of a forecast.

Our work revealed that the forecasting task has two different but intricately related aspects. The pragmatic product based view focuses on the details of a particular forecast product. It corresponds to the common conception of the forecasting task, is relatively well understood and has been adequately described and documented (eg Bally, 2002; Linger & Burstein, 2001). Importantly, it also corresponds to the perception of the forecasting task amongst the forecasters themselves. This aspect is in the Known and Knowable sectors of the Cynefin model. On the other hand the cognitive based view has not been well documented. It focuses on the underlying group activity of the forecasters and involves the continuous maintenance of their understanding of the weather and guidance data- Cynefin's Complex domain.

These empirical studies detail how a complex, knowledge based task is performed in a socio-technical context, providing insights into collaborative knowledge work generally (Aarons et al., 2005, 2006). Some key findings include:

- an evolving 'mental picture' of the object of work, the weather system, is of paramount importance to task performance
- the formal and informal interactions between actors, the forecasters, are a significant factor in the task process
- the work environment is characterised by disruptions and demands for "non-standard" products and both aspects of task performance, the pragmatic and cognitive based activities, must be resilient to accommodate such a context
- the actor's intimate knowledge of their domain, in this case their knowledge of local geography and topology, is a key element in task performance
- the actor's expertise is an expression of their training and extensive experience rather than the volume and diversity of data

- sense-making characterises the interaction between actors involved in task performance and defines the task as a socially constructed activity. The integration of “thinking”, “doing” and “talking” defines work at the team level
- actors simultaneously maintain an individual, team and organizational perspective of the object of work, the “forecast policy”, facilitating their ability to share their knowledge and understanding of the task
- knowledge work is acknowledged, privileged and rewarded by BoM even though the important cognitive aspects remain invisible

This research highlights the significance of sense-making at the intermediate, team level. Collaborative work is task-based and work practices integrate production with cognitive and conceptual activities and facilitate learning and sense-making. While focussing on knowledge based practices, our approach was not oriented to understanding how knowledge is managed, but on the (self) management of knowledge work (Iivari & Linger, 2000).

The Photonics Project: A Multifaceted Socio-Technical Model

Contributing to our understanding of what may be appropriate in a sensible organization has been a research and development project, that has taken place over several years, concerning the evolution of a socio-technical system which brings together the human and technical dynamics of the intricate and highly engaging processes of effective collaboration. The emphasis in this participatory action research has been on the co-creation of socio-technical systems to manage knowledge, thereby giving people what they want and a sense of ownership. Several projects were undertaken with diverse groups of people including subject-matter experts, students, teachers, parents, technologists and business people who work in teams to create a website that could be used to inform high school students about new technologies in the field of photonics. The model that evolved as a successful way to carry out these projects consisted of

- Intensive workshops with input from all participants and including community-building exercises and heterogeneous project team formation.
- 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 groupware system was used for this.)
- Community celebrations where teams show their creative work and explain their new learning and interest to members of the community including politicians, local government officials and the media.

The model begins with a face-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 a virtual environment that actually supports innovative collaborative activities. 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. Over the course of this action research the web-based groupware package was continually improved with feedback from the research. What evolved was a social technical system incorporating the groupware product and the multifaceted model for its use with heterogeneous learning communities.

Developing Web Communities

Some of the more successful knowledge sharing and sense making forums in large commercial firms are communities of practice that are set up, supported or at least sanctioned by the firm (Wenger et al. 2002). The capability of the Web to enable the creation and sustaining of communities is becoming increasingly more common for a wide range of activities, which can be in the commercial as well as non-profit or educational sectors. Some online communities, loosely described as ‘communities of interest’ are managed by the members themselves. In an endeavor to gain a better understanding of how new ICTs can help build social capital and supported emergent creative activities, we have conducted research into the behavior of online communities in civil society.

One research project (Connery & Hasan, 2005) demonstrated the social and commercial value of setting up a web-based regional community portal. This was done by a local private company both as a community service as well as a business venture with the objective of eventually becoming commercially viable in its own right. The business

model was predicated on producing an income stream from local advertising based on the level of activity. It is a subscriber based service with quality locally generated content. Subscribers receive the weekly e-zine in their email to entice their patronage of new content and they are encouraged to recruit new subscribers with competitions and flyers which are circulated at sports functions and nightspots. A major driver of the site is the enthusiasm for the project with rewards to the developers, not primarily financial, but rather the satisfaction of being a leader in a new and exciting endeavor that creates something worthwhile for the community. It may even be that this work can drive social change in renewing a sense of community meeting needs in the city, town and country.

A second community research project (Hodgkinson & Hasan, 2006) was a case where economic and technical expertise from a regional university joined with exceptional artists, working in a struggling local indigenous community, to conduct a project to develop an e-commerce website both to sell their art-works and to promote their rich local culture. Regional communities often encompass the variety of skills and knowledge needed to take advantage of the Internet in order to open up their products and services to the global market place. They can, however, lack the foresight to identify opportunities to bring this diverse capability together and then manage it to carry out projects to successful outcomes. The partnership with the University was a sensible approach to redressing this deficiency. In terms of the Cynefin model, this, and the Photonics project described above, moved the user community from the Complex domains closer to the Knowable, and gave them a tool to deal with complexity.

Perceptions of Middle East Warfighters: a case for network-centrism

Since 2003, the authors have been involved in a research project investigating the human dimensions of future warfighting. This study examines broad psychosocial issues that need to be considered so that the Australian Defence Force (ADF) can develop a force able to fully exploit future technologies and future operating concepts. One component of this research involved conducting semi-structured interviews with personnel who had returned from deployment to the Middle East. The sample was stratified across ranks, Services and gender. Over one hundred interviews, totaling about 130 hours, were conducted with interviewees drawn from all three Services, both genders, and ranks ranging from Private (and equivalents) to Brigadier (and equivalents). One civilian member of the ADO who had returned from the Middle East was also included in the sample. During the interviews, questions were asked about a range of issues some of which were decision-making processes, interdependence between Services, nations (or other agencies), information gathering and sharing, communication flows and channels, important skills and competencies and lessons learnt.

Although each interviewee related their own perceptions and reflections on the issues outlined above, there are several common themes that emerged. In this paper, we will look specifically at two inter-related themes relevant to attributes of the sensible organization – the importance of collaboration and sense-making in an operational environment, however more information on the findings is available elsewhere (e.g. Ali, 2006; Pascoe & Ali, 2006; Warne, 2006).

Interdependence and effective collaboration is at the core of any future Australian military force. In many locations in the Middle East theatre, interdependence with other Services and countries in Joint and Coalition units was a fact of everyday life. Some interviewees found this problematic, while others found that collaboration with other units within the Australian contingent and with the Coalition forces was dependent, to a large degree, on building good relationships. Collaboration provided access to information, equipment, parts and general support. It helped develop an understanding of the situation and the individual's role in it. Good interpersonal relationships, in turn, enabled the development of trust. Often, this trust was consciously developed through face-to-face contact, and once established, facilitated further collaboration.

Effective teamwork was also considered crucial. Aspects of teaming and its significance for achieving operational goals emerged from the interviews. Notably, when asked about the skills and qualities people would look for in team members, integrity, maturity, adaptability, flexibility, competency, and a sense of humor were rated highly. Having worked with other team members before was also an important factor for many interviewees.

This research, to date, strongly suggests that the way in which humans organize themselves, share information, work together and cooperate in a network-centric environment has much more than might be expected in common with the way they manage in less technologically sophisticated situations. More specifically, it is evident that the establishment of relationships at a personal level through face-to-face and often socially mediated means can not only be of assistance but even be crucial in enabling more effective cooperation to occur between different organizational entities than would otherwise be the case. It is the knowledge and understanding gained of the other

party, and the trust created as a result of this type of interaction and relationship building, which forms the basis of successful working links between the different parties concerned.

Computer networks and sophisticated communication capabilities may form an important and even major part of the actual mechanism by which information sharing and other cooperative activities occur and are managed, but evidently, the initial decision to share and cooperate does not happen just because the technological means or even the situational imperative exists to do so, but rather because the relevant relationships pre-exist or the necessary effort has been invested in creating them. Interestingly, and not incompatibly with the foregoing findings, a major benefit of the networked nature of the forces in Iraq was the morale boosting effect on the personnel there - of their ability to use the network technology to continue and nurture their relationships with family back home. The technology tends not, of itself, to lead to the creation of new relationships or links but rather is more important in supporting those that have been established through other means.

Corporate Wikis: Appropriating Social Technologies for Business

Technologies such as Wikis, weblogs and chatrooms are continually being appropriated from their popular use in civil society for knowledge work in commercial and government and even military enterprises. At the current time, a new civil digital culture has taken hold, in which so-called 'social' and/or 'conversational' technologies are providing unprecedented opportunities for everyday civil user activities. The attraction of these social technologies is their low cost, intuitive functionality and connectivity. Social technologies provide computer-mediated environments that use applications such as Wikis and various web-based groupware systems. They support new forms of informal, network-centric interaction and activity between people, allowing and enhancing informal access to create and distribute information. These technologies empower ordinary people to have a global presence for business, political and social purposes. The new social technologies at the focus of this project are tools of a rising digital democracy. They give users a new flexibility and independence to support collective actions, knowledge sharing and decision-making by self-directed groups. This project is studying how organizations are transforming from traditional hierarchical structures with top-down control to more emancipated, network-centric configurations, supported by cooperative socio-technical systems. While social technologies have potential benefits for corporate use, they pose challenges for formal organizations as attempts are made by end-users to appropriate them as suitable tools for knowledge work activities.

Preliminary results of an exploratory study of corporate wikis (Pfaff & Hasan, 2006) identified issues of concern, such as control, security, intellectual property rights, and reward for employee participation, that are facing corporations that endeavor to democratize their knowledge management processes through the introduction of Wikis. A more detailed study has been conducted of the Research and Development (R&D) division of one organization where a Wiki had been operational for some time but the manager was not happy with the level of user participation by his employees. He recently approached the author's research team to investigate the attitudes of users to their contribution of items to the Wiki. A series of focus groups with the R&D employees has opened up discussions regarding the rationale behind the Wiki project. They also produced the list of employee concerns and attitudes to the Wiki which included.

- More transparent management approval: rewards, incentives, mandated as part of the job description
- Guarantee of permanence— a place in the organizational culture and processes so that current efforts were not a waste of time
- Clarification of the value to users, contributors and customers, plus clarity of purpose
- Making the Wiki more usable, more structured, better organized, more functionality
- Integrating the Wiki with other knowledge management systems to give a single source of information
- The need for more users (i.e. a critical mass)

This ongoing research acknowledges the position of corporate knowledge workers in regard to their needs, rights, capability and responsibilities as users of the web-based social and conversational technologies that are an integral part of their non-corporate lives.

Go*Team for Network-Centric Organizations

In order to investigate the various phenomena that our field studies have identified we have, over the past 2 years developed, and experimented with, the Go*Team game (Hart et al. 2006; Jagiello et al. 2006; Warne et al. 2006) as will now be described. Go*Team is designed to simulate situations in which people and groups coordinate, cooperate and share information, to achieve organizational goals in the anticipated future network-centric environment. Although Go*Team was created for the military, such situations also exist in other government, business and community settings. Go*Team can be applied in order to gain a better understanding of the collective processes and behavior of the people in all network-centric configurations. Of particular interest are human or group related factors that may impede or even prevent the successful achievement of network-centric coordination, cooperation and information sharing despite the availability or presence of the technological capability to support it. For the benefits of network-centrism to be realized, traditional business competition must be tempered with a more cooperative culture both within the organization and across organizational boundaries. Ephemeral attributes such as sharing, trust and collective development are now valued along-side more traditional work skills.

Go*Team is a computerized client-server team version of the ancient Chinese strategy game of Go. The project to develop Go*Team has taken over two years from its original inception to its current state where the software application is operational and several trial games have been played. There are a variety of stakeholders involved in the project. The proposal came from a researcher who originally conceived of the idea and was given leave for much of the development time to work with others on the project. These included software and interface developers, other researchers and the sponsors of the project from the military.

Traditionally, Go is played with black and white stones on a 9x9 to 19x19 grid where individual players take turns to place their stones,. Unlike standard Go, teams playing Go*Team no longer have to take turns; a team's next turn can be taken after a "relaxation time", specified via the server, regardless of whether or not the opposing team has done anything in the interim. There is also no preset command structure built into the Go*Team game. As far as the game software is concerned all team members are peers; with no predetermined roles and there is no "team leader" with more power or capabilities than other team members. The client screens for each player show only a partial view of the board so that there is a need for team members to communication their view of the board to others as well as to discuss strategies. Players on the same team make use of modern communication tools such as email, voice over IP, chat rooms and the like, to effect the cooperation and coordination they need to successfully play the game.

The Go*Team game places its players in an environment exhibiting a number of the features outlined above in order to explore how they function in that environment, the techniques they prefer to use, the techniques that are more successful, and the barriers that may inhibit them from operating as effectively as a team as they otherwise might.

There are a considerable number of variables and factors that can be determined, set and/or measured when playing Go*Team. These must be viewed in terms of network-centric attributes so that the playing of the game reflects those attributes. The Go*Team conditions, factors and variables align with those of network-centrism. Greater understanding of the area is coming from findings from our current research which analyses and interprets Go*Team game sessions between selected teams.

Lessons from our Research for the Sensible Organization

In order to match their volatile environments, most enterprises today espouse the idea that they are a learning organization able to transform themselves as needed in a creative and informed manner. The first four of our research studies articulate lessons on attributes that are critical for organizational sustainability and growth. The ADO research recognizes the critical role of social learning to the growth of modern enterprises and the importance of developing a culture of empowerment, trust, forgiveness etc. This research confirms the results of the weather forecasting study in which the intermediate or group level of organizations is the main site for social learning. This research shows that collaborative knowledge work is often invisible, in terms of defined products, but is essential to the development of expertise and innovation in the socio-technical system. The Photonics project demonstrates the benefits of multi-faceted teams where diverse skills and capabilities can be supported in a mix of face-to-face and online collaborative spaces and viewed holistically as socio-technical systems. This work reinforces the importance of trust, empowerment, forgiveness, openness, commitment and recognition found in the work on social learning in the ADO. To better understand how fundamental these elements are to successful cooperative human activity, the fourth research study has investigated how communities work in civil society enabled by Web-based applications.

The first four research studies relate to socio-technical aspects, and human dimensions of, organizational systems that have often been the focus of IS research in the past. While these continue to be of vital concern, the foci of the next two studies are emerging as fresh topics of current interest to IS as they focus on skills needed in a network-centric environment and on the corporate appropriation of social technologies. The study of the perceptions of Middle East Warfighters identified that effective teamwork was considered crucial in achieving operational goals. This finding supports the slow transformation of the traditional command and control of the military into a more network-centric structure but it is also a driver for that transformation. Analysis of interviews showed that integrity, maturity, adaptability, flexibility, competency, and a sense of humor were rated highly among the skills and qualities people would look for in team members. The study of corporate Wikis reveals a new attitude to the needs, rights, capability and responsibilities of knowledge workers in regard to their roles as users of the web-based social technologies, collectively, and to the control of their own knowledge management processes. Both studies emphasize Snowden's (2002) observations that the unsettling state of constant change and the complexity of the workplace continues to increase to a level where rational scientific management practices are no longer appropriate and other more organic approaches may need to be adopted.

The issues raised by all these studies point to changes that are necessary for transformation to a sensible organization. The complex environment presents organizations with a very large range of problems and opportunities. Organizational response to this diversity of inputs is ideally to become agile, flexible and adaptable by transforming their structures and processes. Such a response is consistent with Ashby's Law of Requisite Variety (Ashby, 1957) as the organization attempts to construct itself as an entity that can match the variety that it confronts in its environment. Thus, for example, a network-centric structure allows the organization to be more flexible than a more rigid hierarchical command and control structure in order to adapt itself dynamically to changes in the environment. Additionally, network-centric structures are dependent on small autonomous, self-directed and self-coordinating groupings. Such groups are more apt at recognizing and understanding changes in the activity system for which they have responsibility, and have the expertise and authority to act on that understanding. Such action, within a network-centric structure, impacts on other groups who in turn take action. The flatter hierarchical structure, combined with a network-centric structure, provides the organization with the variety to dynamically interact with its environment, while also having the capability to make sense of its situation from a broader, more abstract and longer term perspective and to act on that understanding.

Where organizations are adopting network-centric practices within a hierarchical bureaucracy, they face the challenge of imposing culture change much more rapidly than it would normally occur. Managers are having to relinquish some of their traditional control to small self directed teams while workers must increase their situational awareness in order to take on more responsibilities and exercise authority within a small, less prescribed group setting. This is a considerable change from the way they would have operated in the past and often there is little training or even understanding of the skills and capability needed.

The last research study takes us into the future to justify the adoption of alternative, more flexible management and training techniques which include the use of gaming systems such as Go*Team. Go*Team has created a simulation of team-work in order to better inform this aspect of the network-centric structure, and to integrate players into a rapidly changing environment. Taking a socio-technical systemic view of Go*Team quickly reveals the complexity both of the system itself and the context of its use. There are many technical and human components involved, with multiple relationships between them. Go*Team is designed to embed its players in an environment that involves conflict (with the other team or teams involved in the game), cooperation and coordination, but also competition (with and between the players in one's own team), uncertainty, complexity and information sharing (through the need to continually synthesize, in a dynamic situation, multiple fragmentary and local perspectives into an overall situational picture), timely and appropriate decision making (through the need to balance the time taken for adequate situational analysis and the pressure to avoid being overtaken by events) (Hart et al 2006). The game provides a suitable platform to explore a variety of aspects that characterise the sensible organization and the interdependencies and integration of these aspects. The question now arises as to what outcomes can be achieved when this is done and for whom. This is the challenge for future research with, and possible commercialization of, Go*Team as a tool for team-building, situation awareness and, ultimately sense-making in the sensible organization. There is considerable literature that supports the use of simulations that represent varied organizational contexts to enhance understanding and modify behavior (e.g. Leigh, 1999). Go*Team, and other games like it, will have broad applications for business, government and community organizations.

Conclusion: The New Agenda for IS

Large bureaucratic organizations, and the people who work in them, are facing rapid and substantial changes which require new understandings, skills and capability for the network-centric environment. Many organizations are now hybrids of a traditional hierarchy, with a limited command and control structure, allowing the emergence of self-directed groups in a network-centric configuration. The domain of network-centrism now encompasses the organizational, social and cultural, as well as the technical, aspects of working in these changing, hybrid environments. In terms of the Cynefin framework, information systems have a long history in automating aspects of the Known and Knowable domains, the challenge now is to support the Complex domain.

Our research targets the sometimes chaotic, complex environment of the agile, social, networked organization and related communities. Here it makes sense to see all work as knowledge work where all employees or members are knowledge workers engaged in activities that meld thinking and doing. People in this environment need the authority, skills and capability to work effectively and creatively in teams as much as they need the traditional operational skills to do their job. In a sensible organization such work needs to be recognized and rewarded. Management in this environment will need to encourage sense-making and exploration rather than resort to traditional methods of setting objectives and measuring outcomes. A sensible organization of the future will involve a culture that promotes social learning, community/team building and the appropriation of new flexible technologies in emergent socio-technical systems. In this paper we suggest that a fresh agenda is required for the IS community to ensure research and practice is relevant to this new complex environment.

We have identified our research as core to IS using Batterham's (2003) Mode 2 approach. While we continue to do field work, we are also using the simulation and gaming approach of Go*Team. The diversity of methodological approaches provides us with a means of retaining the holistic and socio-technical nature of research into what we see as these critical aspects of the sensible organization. We see sense-making as a concept that can underpin a new IS approach to research and allow sensible organizations to emerge from much of the chaos that has arisen from a general lack of understanding of the social effects of ICT and the Internet.

Our early empirical research provides evidence from which we can learn from past mistakes where many IS projects assumed an outmoded organizational context of operation. The findings demonstrate the crucial role of social learning to the development of an organizational culture of cooperation and the creation of an environment for innovation through collaborative knowledge work. For this, IS needs to expand its focus from organizational requirements and individual users to the support needed for employees working in self-directed groups and teams. Our more recent research is reporting trends where network-centric approaches are being considered in the complexity of the modern workplace together with the appropriation of social technologies to enable more democratic management of collective knowledge.

Where organizations are adopting network-centric practices managers are having to relinquish some of their traditional control to knowledge workers in small self directed teams. These workers should be provided with meaningful training to increase the skills and capability required to take on more responsibilities and exercise authority within a small, less prescribed group setting. This takes us into a future which could include the use of gaming systems such as Go*Team, which embeds them in a realistic but simulated team environment requiring them to cooperate through communication and information sharing to coordinate decision-making and action,

It is our contention that many previous IS projects have assumed an outmoded organizational context of operation, and despite the exponential development of the technology, are not keeping up with the rapidly emerging organizational paradigms that require more flexible, people-oriented systems. Furthermore, our research has shown that the use of relatively new social technologies will very likely prove to be the growth area for IS, both in organizations and in the community in general. IS research and practice needs to embrace the emergence of the sensible organization by routinely incorporating cultural investigations into user requirements analysis to facilitate a sound understanding of existing work practices in terms of both social and functional preferred processes and networks. In this way, we can specify true socio-technical systems that not only automate the work, but support the way it is done and enhances productivity and the work experience itself.

References

- Aarons, J., Burstein, F. & Linger, H. (2005), "What is the task? – applying the Task-based KM framework to weather forecasting", in Burstein, F. and Linger, H. (eds) *Organisational Challenges for Knowledge Management*, Australian Scholarly Press, Melbourne, Australia
- Aarons, J., Linger, H. & Burstein, F. (2006), "Supporting organisational knowledge work: Integrating thinking and doing in task-based support" *Proceedings of the International Conference On Organizational Learning, Knowledge And Capabilities, OLKC 2006*
- Ali, I (2006) "Information sharing and gathering in NCW environment: voices from the battlespace", in the *Proceedings of the 11th International Command and Control Research and Technology Symposium*, 26-28 September 2006 Cambridge, UK, http://www.dodccrp.org/events/11th_ICCRTS/iccrts_main.html
- Ali, I., C. Pascoe, L. Warne. (2002) Interactions of Organizational Culture and Collaboration in Working and Learning. *Educational Technology and Society* 5(2): 60-69.
- Amin, A. (1994), *Post-Fordism: A Reader*, Blackwell, Oxford.
- Ashby W. R. (1957) *An Introduction to Cybernetics*, Chapman & Hall Ltd, London now available electronically, <http://pcp.vub.ac.be/books/IntroCyb.pdf>
- Bally, J. (2002) Forecast Information Flows Analysis. Bureau of Meteorology internal technical report.
- Bannon L (1992) "Perspectives on CSCW: From HCI and CMC to CSCW", *International Conference on Human-Computer Interaction (EW-HCI'92)*, St. Petersburg, Russia, August 1992 , 148-158
- Batterham R. (2003) E-Science: A Frontier Technology For Achieving The National Research Priorities http://www.glassearth.com/seegrid_pdf/seegrid_batterham.pdf
- Burstein, F. and Linger, H. (2003), Supporting post-Fordist Work Practices: A Knowledge Management Framework for Dynamic Intelligent *Decision Support*, Drucker, P. (1959).
- Cecez-Kecmanovic D. Jerram C. A (2002) "Sensemaking View of Knowledge in Organisations" *Proceedings of ECIS2002*, Gdansk.
- Checkland, P. (1981), *Systems Thinking, Systems Practice*, Wiley, Chichester.
- Coakes E (2002) "Knowledge Management: A SocioTechnical Perspective", in E. Coakes, D Willis and S. Clarke eds, *Knowledge Management in the SocioTechnical World*, Springer- Verlag London, 4-14.
- Connery, A. . Hasan, H. (2005) Social and Commercial Sustainability of Regional Web-based Communities, *Journal of Web-Based Communities* 1/3 246-261.
- Crawford K. Hasan H. 2006 The Co-evolution of an Accessible but Secure Virtual Space for Collaborative Activities *Proceedings of 19th Bled eConference on eValues Bled, Slovenia*,
- Daft, R. L. and A. Y. Lewin. (1993). "Where are the theories for the "new" organizational forms? An editorial essay." *Organization Science* 4(i-vi).
- DeLone W.H. and McLean E.R. (1992) "Information Systems Success: The Quest for the Dependent Variable", *Information Systems Research*, 3(1), 60-95
- Edmunds, A. and A. Morris. (2000). "The Problem of Information Overload in Business Organisations: A Review of the Literature". *International Journal of Information Management* 20: 17-28.
- Etzkowitz H. Leydesdorf, L. (2000) "The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university–industry–government relations", *Research Policy*, 29, 109–123
- Fortune, J. and Peters, G. (2005) *Information Systems: Achieving Success by Avoiding Failure*, Wiley, Chichester.
- Gibbons M. Limoges C., Nowotny H., Schwartzman S. Scott P. and Trow M (1994). *The new production of knowledge: the dynamics of science and research in contemporary societies*. London: Sage
- Gregor S. (2002) "A theory of Theories in Information Systems", in S. Gregor and D. Hart, *Information Systems Foundations: Building the Theoretical Basis*, ANU Canberra, 1-20
- Hart D., Eronen M., Jagiello J., and Warne L. (2006) "Go*Team: A Team Version of Go for Investigating Cooperation, Coordination and Information Sharing in Network-Centric Warfare Environments", *Proceedings of SimTect06*, Melbourne.
- Hart, D. and Warne, L. (2005) "Comparing Cultural and Political Perspectives of Data, Information, and Knowledge Sharing in Organisations" *International Journal of Knowledge Management*, 2(2): 1-15
- Hasan, H. (1999) The mediating role of technology in making sense of information in a knowledge intensive industry. *Knowledge and Process Management* 6, 72-82.
- Hasan H. (2006a) Innovative Socio-Technical Systems for Complex Decision-making, *IFIP8.3 DSS Conference*, London
- Hasan H (2006b) Design as Research: Emergent Complex Activity, *Proceedings of 17th Australasian Conference on Information Systems*, Adelaide, December.

- Hasan, H. and Crawford, K. (2003a) A multifaceted approach to distributed communities of learning and practice, *Proceedings of ISGLOB03, IFIP 8.2/9.3*, Athens.
- Hasan, H. Crawford, K. (2003b) Socio-Technical Systems for Knowledge Mobilisation in Communities, *Proceedings of ACIS2003*, Perth.
- Hodgkinson A. Hasan H (2006) Blending Diverse Community Capability For Regional Development: The Case Of An E-Commerce Initiative For Local Indigenous Artists, *Proceedings of 28th Annual Conference of the Australian and New Zealand Regional Science Association*, Beechworth, Vic.
- Iivari, J., Linger, H. (2000), "The characteristics of knowledge work: a theoretical perspective", *Proceedings of the Americas Conference on Information Systems, AMCIS'2000*, Long Beach, CA, August,
- Jagiello J. Eronen M. Tay N. Hart D. Warne L., Hasan H. (2006) Simulation Framework as a Multi-User Environment for a Go*Team game *Proceedings of ISAGA 2006*, St Petersburg
- Josserand E (2004) *Cooperation within Bureaucracies: Are Communities of Practice an Answer, M@n@gement*, 7/3 307-339
- Latour, B. (1990) "Drawing Things Together" in Lynch, M. and Woolgar, S. (eds). *Representation in Scientific Activity*, pp. 19-68. Cambridge, Mass: MIT Press.
- Leigh E. Kinder, J. eds (1999) *Learning through fun and games*, McGraw Hill Sydney
- Linger, H., Burstein, F. (2001), "From computation to knowledge management: the changing paradigm of decision support for meteorological forecasting", *Journal of Decision Systems*, special issue on "Decision support systems in action", Vol. 10 No. 2, pp.195-216.
- Linger, H. Warne, L. (2001) Making the Invisible Visible: Modelling Social Learning in a Knowledge Management Context, Special Issue on Knowledge Management of the *Australian Journal of Information Systems*, pp56-66.
- Lyytinen K. Hirschheim R. (1987) "Information Systems Failures - A Survey and Classification of the Empirical Literature", *Oxford Surveys in Information Technology*, 4, 257-309.
- Oppenheim, C. (1997). Managers' Use and Handling of Information. *International Journal of Information Management* 17: 239-248.
- Pascoe, C. Ali, I., (2006) "Network Centric Warfare and the New Command and Control: An Australian Perspective", in the Proceedings of the 11th *International Command and Control Research and Technology Symposium*, 26-28 September 2006 Cambridge, UK, http://www.dodccrp.org/events/11th_ICCRTS/icrts_main.html
- Peltokorpi V.Tsuyuki E. (2006) Knowledge governance in a Japanese project-based organization, *Journal of Knowledge Management Research and Practice* 4/1: 36-45.
- Pfaff, C.C. Hasan, H. 2006, Overcoming organisational resistance to using Wiki technology for Knowledge Management. In Proceedings of the 10th Pacific Asia Conference on Information Systems, Kuala Lumpur, Malaysia.
- Prinz W. Kock M. (2007) "Why CSCW Research Web 2.0 and Social Software solve our problems anyhow!" workshop at *ECSCW07* Limerick , URL <http://lubnalam.wordpress.com/2007/06/18/workshop-why-cscw-research-web-20-and-social-software-solve-our-problems-anyhow/>
- Robbins, S.P. (1990) *Organization Theory: Structure, Design, and Applications* (3rd ed). Englewood Cliffs, New Jersey: Prentice-Hall.
- Sauer C. (1993) *Why Information Systems Fail: A Case Study Approach*, Alfred Waller.
- Scholtz V. (2002) "Managing Knowledge in a Knowledge Business", in E. Coakes, D Willis and S. Clarke eds, *Knowledge Management in the SocioTechnical World*, Springer- Verlag London, 43-51.
- Sellen A.J. Harper R. (2001) The Myth of the paperless Office,
- Senge P. (1994) *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday.
- Shenk, D. (1997). *Data Smog: Surviving the Information Glut*. Abacus Publishing.
- Snowden, D. (2002) Complex Acts of Knowing: Paradox and Descriptive Self-Awareness. *Journal of Knowledge Management*, 6(2).
- Stanley, A. Clipsham. P. (1997). Information Overload - Myth or Reality. *IEEE Colloquium Digest* 97(340): 1-4.
- Sterman J. (2000) *Business Dynamics; Systems Thinking and Modeling for a Complex World*, Irwin McGaw-Hill, Kingsport, USA.
- Warne, L. (2000). "A Sociotechnical Approach to Social Learning Analysis in the Australian Defence Force". *The New Sociotech: Graffiti on the Long Wall*. E. Coakes, R. Lloyd-Jones and D. Willis (eds). London, Springer-Verlag for the British Computer Society.
- Warne, L. (2002). Conflict and Politics and Information Systems Failure: A Challenge for Information Systems Professionals and Researchers. *Socio-Technical and Human Cognition Elements of Information Systems*. S. Clarke (Ed). Hershey, PA, Idea Group. ISBN 1591401046: 140-135.

- Warne, L. (2006) "NetworkER Centric Warfare: Outcomes of the Human Dimension of Future Warfighting Task" TTCF Symposium – Human Factors Issues in NCW. 1-3 May 2006 Sydney, Australia. Online: <http://www.dsto.defence.gov.au/events/4659/>
- Warne, L., Ali, I., Bopping, D., Hart, D. and C. Pascoe. (2004) *The Network Centric Warrior: The Human Dimension of Network Centric Warfare (U)* DSTO Report CR-0373, Defence Systems Analysis Division, ISL, Defence Science and Technology Organisation, Department of Defence, Edinburgh, S.A. (Approved for Public Release).
- Warne, L., Ali, I., and C. Pascoe (2003) *Social Learning and Knowledge Management – A Journey through the Australian Defence Organisation: the Final Report of the Enterprise Social Learning Architectures Task*, DSTO Report, DSTO-RR-0257, Defence Systems Analysis Division, Information Sciences Laboratory, Department of Defence.
- Warne, L., Ali, I., Pascoe, C. and Agostino, K., (2001) A holistic approach to knowledge management and social learning: lessons learnt from military headquarters, *Australian Journal of Information Systems*, Special Issue on Knowledge Management, December, pp127-142.
- Warne, L., Hasan, H. and I. Ali. (2005a). Transforming Organizational Culture to the Ideal Inquiring Organization: Hopes and Hurdles. In J. F. Courtney, J. D. Haynes, & D. B. Paradise (Eds.), *Inquiring Organizations: Moving from Knowledge Management to Wisdom*. (pp. 316-336) Hershey, PA: Idea Group.
- Warne L., Ali I. and Hasan H. (2005c) The Network Centric Environment viewed through the Lens of Activity Theory, in G. Whymark and H. Hasan (eds) *Activity as the Focus of Information Systems Research*, Knowledge Creation Press, UCQ, 117-140.
- Warne L., Hasan H., Hart D. (2006) Go*Team a new approach to developing a knowledge sharing culture, *Proceedings of the Australian Conference of Information Systems*, December 6-8, Adelaide.
- Warne, L., Pascoe, C., and I. Ali. (2005b). Painting with and without numbers: The use of qualitative and quantitative methods to study social learning. *Australian Journal of Information Systems*, (AJIS) 12(2), pp112-133. ISSN 1449-8618.
- Weick, K.E. (1995). *Sensemaking in Organizations*. Sage.
- Wenger E. McDermott R. Snyder W. (2002) *Cultivating Communities of Practice*, Harvard Business School Press, Boston.
- Wiley, N. (1994). *The Semiotic Self*. Polity Press, Cambridge.
- Zuboff, S. (1988) *In the Age of the Smart Machine, The Future of Work and Power*. Oxford: Heinemann.