

# **From Traditional Knowledge Management in Hierarchical Organizations to a Network Centric Paradigm for a Changing World**

## **Abstract:**

At the beginning of the 21<sup>st</sup> century, all organizations need to address the continually changing social and economic landscape in which they operate. In this landscape organizations need to be responsive, flexible and agile and acquire the capability to leverage information and use collective knowledge to make appropriate decisions quickly and effectively. The practice of knowledge management allows knowledge workers to participate in dynamic processes that generate and use collective knowledge. However the complexity that arises from a continually changing global environment highlights the need for knowledge management to move in new directions both in practice and theory. This paper proposes approaches to knowledge management that incorporate concepts from complexity theory leading to the adoption of a network-centric paradigm in organizations, complementing or replacing traditional hierarchical bureaucracies.

## **Introduction**

At the beginning of the 21<sup>st</sup> century, all organizations, whether government, industrial, commercial or civil, need to address the continually changing social and economic landscape, in which they operate. A central theme of this change is the emergence of information and knowledge as major elements of wealth creation processes including the growth of intellectual and social capital (Sveiby 1997). The current corporate interest in knowledge is based on a realisation that emerging economic theories, coupled with social and industrial restructuring, demand a more rigorous approach to the exploitation of knowledge, and knowledge making capabilities, as organizational resources (Drucker 1998). As knowledge workers, modern employees are participating in dynamic processes that generate and use collective knowledge in a changing organizational landscape (Ivari & Linger 1999, Pfaff & Hasan 2007).

The practice of knowledge management (KM) is now distinguished from information systems and information management (Hart & Warne 2005, HB189 2004). As encapsulated in the Australian Standard (AS 5037 2005), KM manifests itself in organizations through a variety of interpretations and implementations depending on the enterprise, the pressures for innovation and the market context. KM must contend with the increasing complexity that comes with the continually changing global environment, and the related need to negotiate, test, refine and share complex responses to the resulting challenges. This signals the need to re-evaluate organizational structures and processes to ensure that they appropriately enable these new activities at all levels. We propose approaches to KM incorporating concepts from Complexity Theory leading to the adoption of a network-centric paradigm in organizations, complementing or replacing traditional hierarchical bureaucracies.

In this paper we depict information as data in any media that is available and may be processed to be interpreted by people and thus potentially inform. Knowledge, on the other

hand, can be distinguished as the human capability to interpret information and use it creatively, both individually and cooperatively, to add value to human activities and products. This accords with the Macquarie Dictionary definition of 'social capital' in terms of the investment in institutions, quality relationships and interactions that enhance wealth making processes. Issues raised by these changing environments are:

- transformations in what constitutes wealth and what is valued
- the shrinking distances around the world and global competition
- the compression of time, which increases the tempo of our lives
- the alteration in the distribution of power, including the power that is accrued by custodians of information.

Traditionally, wealth creation was based on land, capital and labour. Now, information and knowledge are major ingredients (Benkler 2006). Creating wealth is about adding value by turning these new ingredients into products and exchanging them through open global markets. Information is a resource for management and decision-making. Information and Communications Technologies (ICT) have made information collection, storage, processing, retrieval, analysis and dissemination cheap, affordable and accessible. Zuboff (1989) argued, almost 20 years ago, that the information age carried with it, not liberation, but the threat that management, and perhaps the state, will use technology to invade more and more of the space previously claimed by workers and citizens for unsupervised, discretionary activity. However more contemporary ICT, exemplified by Internet-based applications, has the potential to significantly reduced control over emerging information and the knowledge derived from creative applications of new information (Pfaff & Hasan 2007).

ICT are changing the space and time dimensions of value-adding activities and patterns of social capital investment by making information available at any physical place, reducing the

dependence on location, and compressing process cycle times and decisions (based on information) about such processes (Coakes 2002). Because information often changes rapidly and can be interpreted more or less effectively according to the knowledge of people using it, wealth creating processes and the opportunities that are associated with them now change more often and more rapidly. In such a changed landscape, organizations need to be responsive, flexible and agile. In other words, they now need to have the capability to leverage available information and to use their collective knowledge to make appropriate decisions quickly and effectively. This need has driven the KM movement in new directions for both practice and theory.

These changes have increased the complexity of organizational landscapes and the intricate processes carried out by people within them to a point where traditional hierarchical organizations no longer provide a platform for effective and efficient management and operations. The lack of success of traditional knowledge management initiatives highlights the need to adopt approaches that are informed by concepts derived from complexity theory, learning, action science and other theoretical positions that explicitly address complexity. An example of such an approach is the knowledge eco-system concept on which the Australian KM Standard is based. In this paper, we propose a network-centric paradigm for knowledge management in complex organizational landscapes. The paper maps the journey the writers have made in defining this new paradigm. The paradigm is based on their collective case studies, from the military and community organizations and from the writers' reflections on the recursive nature of their own collaborative research as it negotiated its own levels of complexity, emergence, efficacy and tempo.

## **Complexity: The dimensions of the changing world**

Using the Cynefin model of complexity (See Figure 1 below) the dimensions of the changed landscape can be characterised by:

- An increased shift towards the *unordered* half of the model
- A reliance on the detection and leveraging of emergent patterns rather than pre-planning and design
- Efficacy working comfortably and effectively in this environment
- An awareness of, and adjustments to, variations in tempo. For example, changing culture is usually a long process whereas other changes happen rapidly

Problems faced by organizations, whether in operations, structure or processes, can be explained in terms of these dimensions. This section will discuss how these aspects of the landscape shape the issues that confront organizations in the real world.

### **[Figure 1 about here]**

The Cynefin framework is a knowledge space with five domains which set the context for collective decision making: two domains of order, the known and the knowable with the unordered domains of complexity and chaos. The domain of disorder provides a negotiable space for choices about strategic responses to new situations.

Firstly, the increased emphasis on dealing with complex situations for which established knowledge and practices are ineffective often produces feelings of fear and perceptions of chaos. In the face of these situations (Represented in the bottom left hand domain of the model) there are two common responses:

- Retreat to the established ordered position and reinforce the rules of engagement to avoid chaos and prevent disorder

- Begin creative learning processes to explore the reasons for the apparent ‘chaos’ and understand the complex situation and use that understanding to leverage from emergent information and test the validity and effectiveness of response options.

Perceptions of, and chosen responses to, *unorder* are a reflection of working knowledge and interpretations of complex settings, personality differences and comfort levels in ambiguous situations requiring creative responses. The same environment can appear familiar and interesting, or *unordered* and chaotic to different people according to experience and world view. In traditional hierarchical organizations there is often an experience and knowledge gap between senior executives, who generally work in an ordered environment, and their younger knowledge working colleagues. The latter generally work at the periphery of an organization, have more recent qualifications, are more flexible about learning and consulting with each other, and are dealing with *unorder* by informally adding value to current knowledge and processes on a day to day basis.

Snowden (2002) identifies three generations of knowledge management. The first generation, clearly associated with increased ICT capabilities, focussed on timely information provision for decision support. The second generation, triggered by the SECI model (Nonaka 1994), focussed on the tacit-explicit knowledge conversion as the one process of knowledge creation in organizations. The emerging third generation, associated with Snowden’s work at the Cynefin Centre, uses complex adaptive systems theory to create a sense-making model of collective knowledge creation, disruption and utilisation that allows a pragmatic and conceptual alternative to the orthodoxy of scientific management. In the case studies presented below, it appears that first generation KM fitted comfortably into traditional hierarchical bureaucracies whereas maturation to the third generation follows the trend to

more organic network-centric configurations where a knowledge eco-system approach makes sense, as will be explained below.

The defining characteristics of the network-centric organization are flatter hierarchies; decentralised decision-making; greater capacity for tolerance of ambiguity; permeable internal and external boundaries; empowerment of employees; capacity for renewal; self-organising units, and self-integrating coordination mechanisms (Daft & Lewin 1993). In such organizations, knowledge is the most strategically important resource and organizational capabilities are the product of distinctive competencies in integrating and applying this knowledge. Thus active participation in communication is the pervasive, underlying force responsible for maintenance and dissemination of strategic capabilities based in knowledge. In this paradigm, there is distributed decision making and self-organization where attractors and barriers replace command and control. Participants are motivated (attracted) to participate with authority and initiative in activities around emergent aspects of the situation and have clearly understood boundaries for such actions. They also have responsibility to share the results of their participation in order to integrate strategic actions across the network (Allee 2002). Tucker and Meyer (1996) point out that strategic capabilities result from new knowledge creation accomplished through a combination of individuals' tacit and objective knowledge, yet this collection of knowledge must somehow be aggregated and communicated at a collective level (Warne et al 2004).

In hierarchical organizations faced with rapidly changing contexts, an over emphasis by powerful senior executives on compliance, accountability, control of planning, and reinforcement of rules can slow the tempo of, and reduce, participation in, decision making and can also prevent those at the periphery of an organization from paying attention to emergent patterns and making the necessary adaptations.

In a complex and rapidly changing setting, successful and agile responses depend on capabilities for detection and leveraging of emergent patterns. Research (Whelton & Ballard 2003) also indicates that these capabilities involve intuition and greater awareness (meta-cognition) of strategic development, purpose and the thinking underpinning new responses. In such a context, successful navigation depends on a non-linear process involving the creation of a mix of imposed limits or barriers and strategically placed attractors to explore, understand and eventually leverage emergent patterns and opportunities. The emergent networked business activity surrounding the You Tube video exchange phenomenon (<http://www.youtube.com>), including government participation to distribute drug education materials and the recent purchase by Google, is an example of these kinds of responses.

It has become apparent that in the current climate, awareness of change sometimes occurs rapidly and is leading to rapid changes in patterns of interaction, activity, awareness and capability for some participants in the emerging digital culture. There is now a categorisation of workers based on generational differences, known as baby-boomer, X and Y. According to Smola and Sutton (2002) a generation is “an identifiable group that shares birth years, age location and significant life events at critical developmental stages.” While such generations share common historical and social life experiences, generational characteristics can be distinct from those purely due to age, maturity, experience and corresponding technical competence. However assumptions of ubiquity of emerging digital culture is particularly strong for young people many of whom have not only grown up with far greater access to information than previous generations, but also with developmentally powerful experiences of managing complex settings (for example, interactive multiplayer games), and capability and wide experience in using multiple media, often simultaneously, for wide ranging communication with different people in multiple networks. There is considerable evidence

emerging from the field of neuroscience that such changes in interactive cultural experience change the course of brain development (Prensky, 2001a, 2001b).

The changes in experience, development and emerging values and capabilities also result in different world views. The differences in values and motivation between Generation Y (usually at the periphery of an organization and the Baby Boomers in the senior executive group is now well researched (e.g. Henry, 2007) These differences suggest that each group is likely to have a differing interpretation of and response to complex contexts and related barriers and attractors.

Organizational cultures fulfil needs for stability and often change slowly. However, as mentioned above, the gap between active participants in the emergent activity and those who conduct their lives according to pre-digital conceptions is ever widening. This causes tensions of several kinds. These include:

- A generation gap in digital culture that is acknowledged to be as wide as that between immigrant parents and their children growing up in a new culture (Prensky 2001a, 2001b)
- The tension (already mentioned) between emergent new agile patterns of network centric organizational activity and the well established hierarchical institutional platforms and legal regulation frameworks that have served developed countries for centuries
- Changing conceptions of human rights and responsibilities (e.g. the emergent privacy debate)
- Changing patterns of commitment and participation as people manage in less stable, more global and rapidly changing landscapes.

The increasingly complex settings for knowledge work, and the changing capabilities, strategies, relationships and outcomes in a more *unordered* world, inevitably have an impact on the KM landscape.

## **The KM Landscape**

The orientation of mainstream knowledge management has been organizational with an essentially top-down implementation that relies on the existing organizational hierarchy. Even if the stated objective is to “flatten the structure”, knowledge management initiatives rely on senior “champions” in order to acquire the resources for the initiative and the authority for implementation. Yet knowledge production is explicitly seen as an individual activity. From an organizational perspective, this inherent contradiction is addressed by an emphasis on the sharing of knowledge and the transformation of tacit knowledge to explicit knowledge in parallel to the accumulation of organizational knowledge that is derived from personal knowledge. This effectively appropriates social production in that it applies Taylorist principles to “white collar” managerial work that traditionally has not been subjected to such treatment.

As a consequence much of KM has failed to deliver because those implementing KM initiatives have retained a bureaucratic perspective of work as performed by individuals in a formal organizational structure where knowledge is viewed as a static resource or asset that can be treated in much the same way as any other commodity. As long as organizations retain this perspective, the real nature of knowledge work remains hidden, and thus inaccessible to those who are trying to “improve organizational outcomes” through KM practices (Linger & Warne 2001).

The concentration on formal organizational programs aimed at individual workers ignores the real nature of work practices that reside in a space between the organization and individual perspectives. It is our contention that revealing the nature of this hidden space holds the key to understanding knowledge work and is critical to successful organizational outcomes and learning. Changing the focus of KM to work practices reveals how the work community and

its members conceptualise the work they perform. It also exposes the synergistic roles of the community and its members in the processes of knowledge production and re-production (Burstein & Linger 2003).

As an illustration of this change of KM focus we draw on the Australian KM Standard (AS 5037—2005) which was produced in consultation with Australian businesses and defines knowledge management as follows:

“A trans-disciplinary approach to improving organizational outcomes and learning, through maximising the use of knowledge. It involves the design, implementation and review of social and technological activities and processes to improve the creating, sharing, and applying or using of knowledge. Knowledge management is concerned with innovation and sharing behaviours, managing complexity and ambiguity through knowledge networks and connections, exploring smart processes, and deploying people-centric technologies.”

The Standard's definition of KM is congruent with the notion that most knowledge is created through work in groups and networks that are not visible in the formal organizational structures and processes. The Standard also uses the concept of a knowledge eco-system to represent the core organic nature of KM and provides a more relevant guide to KM for practitioners than the constrained, process-oriented approach currently prevalent in organizations. Figure 2 shows the Australian Standard's presentation of the elements, enablers and other factors of organizational KM as a knowledge eco-system. Individual items within this eco-system could comfortably reside in any one of the domains of the Cynefin model but the whole is a complex dynamic set of interactions between them. The eco-system concept is strongly influenced by notions from Complexity Theory, as described above, where attractors and boundaries replace rules and control. It recognises that every KM initiative is different, because of its unique context and strategic intent, and that the process is organic, informal and

emergent rather than mechanistic and controlled. The knowledge eco-system exposes the invisible aspects of knowledge work vital to the sustainable growth of modern organizations.

**[Figure 2 about here]**

The invisible aspects of knowledge work relate to the upper two domains of the Cynefin model. The process of mapping the knowledge eco-system makes some of the elements, processes, and characteristics of these domains more visible. Participation by businesses in the mapping process expands their awareness of these factors.

The evolving view of knowledge management has shaped our approaches to research and our interpretation of data in the case studies below. The very nature and conditions of work are changing. This necessitates a change in the paradigms used to design and interpret research.

### **Working in a changing world**

As discussed earlier, mainstream knowledge management has been largely concerned with the nature of knowledge in organizations, the knowledge processing capability of the organization, technology for knowledge processing and valuing knowledge in organizations. This perspective is essentially structural and hides the object of work that is the basis of knowledge management.

In the authors' view of the KM landscape, these approaches, which focus on the organization as a whole or the tacit knowledge of the individual, are not robust enough to service the complex changing world. In the authors' middle-out approach to KM the entities and context of KM form a complex set of inter-relationships that are best described as an organic knowledge eco-system rather than a machine or bureaucracy. Indeed, the development of this approach has revealed that the issue critical to organizational growth and learning is not what is now considered KM but rather the phenomenon of knowledge work.

The term 'knowledge worker' is attributed to Peter Drucker, who over forty years ago used the term to describe someone who adds value by processing existing information to create new information which could be used to define and solve problems (Drucker 1959). Burstein and Linger (2003) have taken up Drucker's term "knowledge work" to refer to self-directed work practices of individuals and teams in almost every industry who continuously engage in processes that create and exploit knowledge. They go on to describe knowledge work as an activity system "located within the space defined by the *doing, thinking and communicating* dimensions. In order for actors to move seamlessly anywhere in this three-dimensional space, they need to have authority and responsibility that allows them to determine task outcomes." In our view, the purpose of knowledge work is a critical element that shapes behaviour and outcomes. Likewise, Rogoski (1999) says of knowledge workers: "Their main value to an organization is their ability to gather and analyse information and make decisions that will benefit the company. They are able to work collaboratively with and learn from each other; they are willing to take risks, expecting to learn from their mistakes rather than be criticized for them." Haedrich and Maier (2004) also note that knowledge work is typically characterised by attributes such as mobility, flexibility, teamwork, computer-support and the use of intellectual abilities as well as specialised knowledge rather than physical abilities. It is creative work solving unstructured problems that require exploration or creation of knowledge.

In the following section the authors will outline the issues that have emerged from their own empirical investigations, outlining findings from their case studies. The issues are grouped around two main themes: *Situated Activity* as the work system that identifies the actors, intent, relationships, structures and tools; *Collaboration* as the social construct within which the activity occurs. Our intention is to highlight the complexity inherent in work practices that incorporate both the purposeful, productive and intellectual aspects of activity systems.

In the case studies presented below, *situated activity* is described in terms of the following simple questions designed to reveal world views, relationship and strategic intent:

**“Where do you fit in?”** elicits information about shared or individual conceptions of identity, culture, values, power, systems thinking, boundaries, and ways of representing information that shape decisions about the scope of ‘appropriate’ behaviour, strategic options, relationships and the quality of interaction and decision making.

**“What are you trying to achieve?”** focuses attention on the purpose(s), (object(s)) of situated activity, the priorities, commitment, roles and levels of participation that are required.

**“How do you do your work?”** invites descriptive accounts of the structure and organizing principles of the setting as well as information about the dynamics of critical communication, problem solving and production processes. This involves the tools by which activities are mediated by including technologies, institutional processes and structures as well as the context within which they occur.

As mentioned above, collaboration is the social construct within which activity occurs. *Collaboration in situated activity* involves feeling comfortable managing a series of effectors (some negative and some positive) and emergent outcomes in a complex setting rather than a pre-planned linear progression towards a predetermined outcome. In collaboration, the dynamics or quality of interaction and the shareability of information are critical factors. The level of trust between participants and their assessments about the reliability of emergent information or interpretations shape the extent that shared situated activity can become agile, responsive and aligned (and realigned) with maximally effective operational outcomes. Some understanding of the history, competence and interpretive perspective(s) (expertise) of collaborators is important. In this context, capabilities for intuitive thinking, complex data analysis, communication, informal leadership and strategic flexibility are at a premium.

## Case Studies

Over the past decade the authors have conducted and published numerous studies of cases that illustrate the broad spectrum of organizational KM maturity. A representative selection of these will be presented and discussed in terms of current knowledge, situated activity, and collaborative activities. The case studies, all conducted in Australia, will cover the following domains:

1. The tertiary education sector, where hierarchical organizations persist despite early adoption of networking technologies.
2. The military, where moves towards network centricity are changing the traditional command and control culture.
3. Community networking in civil society enabled by Internet-based groupware.
4. A brief reflection on our own cross-institutional collaborative research.

### **Domain 1      Universities as Hierarchical Organizations**

Universities in Australia were early adopters of organizational information and communications systems so that first generation KM flourished in the 1980s and 1990s. In her research (Hasan 1999) chronicled 1990 projects in one university including a data-warehouse (DW) of student course information for line (department) managers, an information audit (IA) to determine sources and users of information, an Executive Information System (EIS) to present summarised performance information to management, an Intranet, managing documents on the web, and a campus-wide infrastructure (CWIS) to manage communications and access to computing resources. Early implementations historically functioned as replacements for previously paper based systems and processes and were oriented towards the needs of administrators. After six years the DW and IA had largely been abandoned. The EIS and CWIS were static and only the Intranet had expanded.

Subsequent developments included an automated form of web-based student enrolment. However one impact of these new systems has been to automate previously more flexible and negotiated transactions within the university. The negative consequences of the automation of student enrolment, reported by one academic student advisor, were the lack of personal contact, diminished control over student choices and having no feel for the type and number of students entering his program of study. There was also much tension evident between the market-driven focus of administrative staff and the teaching styles of academics manifest in continued arguments about quantity, versus quality, of students. The new technology enabled the easy processing of more students and allowed diverse forms of course delivery, including remote sites, but increased the complexity of the work of teaching staff with a lack of support in critical areas, such as moving subject delivery into the new flexible mode. With more work at the coalface, academic staff was disillusioned with the lack of understanding, coherence and direction from the top concerning teaching loads and work practices in a climate where they were being asked to also increase their research profiles.

In follow up research on the impact of information systems on universities (Hasan & Crawford 2002) we found there was a disjunction between the purpose and function of the information systems and the more socially oriented, exploratory and knowledge making social capital development 'objects' of academic work. Apart from standard Internet communications there are no knowledge sharing systems which attempt to codify tacit knowledge, identify intellectual capital or encourage communications between knowledge workers, or connect experts with knowledge consumers. The less flexible, more rule bound automated arrangements appeared linked to new business imperatives and a push from administrative staff towards competition, regulation and cost efficiencies.

The current landscape of KM in these universities is that first generation, focussing on timely information provision for decision support, was embraced early but most have been frozen into legacy systems involving technology, business processes and structures.

These findings are consistent with our research in a second university (also reported in Hasan & Crawford 2002) exploring the objects associated with social capital and capability development, IT implementation and its impact on academic staff. In this study, academic knowledge work was positively associated with email use ( $p > .028$ ), internet applications ( $p > .000$ ) and computer use ( $p > .001$ ). Capabilities for knowledge work were also positively associated with agency or authority. In universities such self reported capabilities are strongly associated with seniority and administrative power in the still largely hierarchical structures.

The complexities of the uneven distributions of expertise and power and their impact on change were evident. The emerging knowledge system, and in particular the emerging knowledge management system associated with university administration, reflects the purposes of those with decision making power and these are not necessarily changing fast. As one staff member reported:

“I’m okay because of my position, the system works well for old fogies like me, but post-grads and younger/ less senior staff have decreasing free time.” [High Level Academic, Arts]

Administrative staff, regardless of their executive level, reported the lowest levels of personal agency of the group. The tensions among academic staff about the resulting conservatism are expressed eloquently as follows:

“The University is losing the wrong people- the good people are going and the bad ones are staying... If you’ve already retired in the job, why would you bother retiring?” [Senior Academic, Science]

Applying the concepts of situated activity, together with collaboration Universities are very complex systems. Traditionally one of their central functions in society has been knowledge work and social capital development to create leaders in society able to assist in responding to challenges and change. With their long history also come forms of hierarchical organization or power and authority with their roots in medieval times. It is clear that the cultural history of technical development and its application in these organizations has had an unintended impact. The balance, in the day to day experience of people has changed. For many, there is less focus on knowledge work associated with research, innovation and creative activity and more on attending to rule based technologies and administrative processes that have evolved from industrial models and organizational processes. It seems to us that this experiment in the industrialization (including co-modification and increased automation) of knowledge work is unfortunate in an era where pressures for agile responses to rapid change have never been greater. Universities which should be leading the way in the knowledge era, appear in our case studies to be the least likely to move into the network-centric paradigm

## **Domain 2        The Australian Defence Organisation (ADO)**

Conversely, the Australian Defence Organisation which is stereotypically considered to be a rigid, traditionally hierarchical organization appears to be adapting well to the knowledge era and the network centric paradigm. The ADO includes the Australian Defence Force (ADF) and the government department that supports it.

In one study, over an extended period of four years, authors from the Defence Science and Technology Organisation in Australia investigated the procedures that facilitate social learning and knowledge management in a number of different settings in the ADO (Ali et al 2001,2002; Warne et al 2001, 2002). The term ‘social’ learning has been used to reflect that organizations, organizational units, and work groups are social clusters, and that learning

therefore occurs in a social context. Social learning represents important processes that contribute to individuals' ability to understand information, create knowledge from that information and share what they know. Social learning is therefore intrinsic to knowledge management.

The research findings highlighted the importance of organizational and/or cultural values for effective social learning and knowledge management practices. In some cases, it was the absence of such values that made their importance clearer. Effective social learning was facilitated by the presence of a set of overarching values:

- *Empowerment* - autonomy to make individuals accountable and increase their sense of ownership of their role in the organization
- *Cultural cohesiveness* - common identity, shared goals and a shared understanding
- *Trust* - entailing mutual respect
- *Forgiveness* - forgiving mistakes and creating knowledge from lessons learnt
- *Commitment* - loyalty to the organization reciprocated by loyalty from the organization
- *Openness of decision making* - transparent processes and information availability to employees at all levels of the organization
- *Sharing of information* – information as an organizational asset not a source of an individual's power base

Apart from the overarching set of values, the research team identified additional sets of factors that support and enable effective social learning. These factors fall into two categories. The first, *Learning Capability Development*, 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 social learning. The learning capability is dependent on the

priorities and objectives of the organization itself and the relative dominance, or perceived importance, of each of the *Values* in different research settings. However, the research also shows that the contribution of *Values* and *Enablers* to social learning is dependent on receptive and supportive organizational structures and processes. This research indicates that these vary across different sectors of the ADO possibly reflecting different cultural histories and different modes of operation and organization. Thus learning capability is nurtured by, and itself nurtures, organizational values that foster effective social learning.

A more recent analysis of this research (Warne et al 2005) observes that technological tools of ever increasing sophistication are available for use in achieving the dissemination and sharing of data, information and knowledge across the organization. However, despite the existence and capability of these tools, knowledge management in many organizations all too often does not deliver the benefits sought from it, and the ideal inquiring organization is still a rarity. The ADO research suggests that organizational, human-related and cultural issues play a pivotal role in the success of knowledge management initiatives. Operating effectively as an ideal inquiring organization in times of change and uncertainty requires flatter organizational structures, a suitable technological infrastructure, relationships based on trust and many other cultural constructs as outlined in this paper.

What is pertinent about this case is that the ADO itself sponsored this work to understand the issues inherent in building learning, adaptive and sustainable organizations. Applying the concepts of situated activity, together with collaboration it indicated that, unlike the rigidity of Universities, change was taking place moving the ADO into at least the second generation of KM. Since the study described above, the focus of the military has shifted to the concept of Network-Centric Warfare (NCW). Although this focus arose out of technical considerations, it is now shifting to place much greater emphasis on the human and social aspects. The

Australian *NCW Roadmap* isolated two dimensions of NCW. The first was the network dimension, referring to the physical systems providing connectivity between sensors, commanders and other parts of the network. The other dimension articulated by the *Roadmap* is the human dimension (Australian Department of Defence, 2005).

Similarly, a more recent study, based on interviews with ADF personnel returning from deployment in Iraq and Afghanistan, determined that under warfighting conditions, relationship building and cohesiveness are necessary ingredients for building situational awareness, achieving agility and, ultimately, securing successful mission outcomes. Furthermore trust is seen as the 'glue' that keeps networkers together and provides an underlying foundation for collaboration and the sharing of information. Data shows that often personal informal networks provide a means to verify situational awareness, often in preference to more formal means (Warne, Bopping et al. 2005).

The importance of contextual factors and the relative inability of electronic communication methods and information systems to provide these came across strongly in the interviews. Moreover, the assumption that more data and information is necessarily better than less was also called into question. A person's understanding of their own situation and also that of the others with whom they communicate plays an important part in shaping how that communication takes place and, consequently, in its effectiveness in conveying intentions, meanings and implications. The technology, therefore, provides only the skeletal structure on which to build a successful communication infrastructure through which the ambitions of network-centric warfare can be achieved (Warne 2006).

As the ADF moves into NCW, facilitated by the increased connectivity made possible by ICT advances, the human and social aspects of this work remain an important focus. In Australia, NCW is considered a key *capability enabler*, a means by which to enhance the overall

warfighting effectiveness of the ADF. The Australian *NCW Roadmap* isolates two dimensions of NCW. The first is the *network dimension*, referring to the physical systems providing connectivity between sensors, commanders and those involved in engaging the adversary. The other dimension articulated by the *Roadmap* is the *human dimension* (Australian Department of Defence, 2005). It is this bilateral transition toward NCW that defines the ADF's adaptation to the demands of a 21<sup>st</sup> century context (Warne 2006), and towards third generation Knowledge Management.

As Generation Y is moving up the ranks in the military, there are emergent changes in the use of Internet and social technologies in the field. Baum (2005) reports that, in Iraq, young platoon and company commanders were exercising their initiative in the face of a lack of training for the conditions they encountered. The younger officers had created for themselves, in their spare time, a means of sharing with one another, online, information that the Army did not control. These officers had been trained by officers of previous generations and equipped to fight against numbered, mechanized regiments in open-maneuver warfare. Instead of looking up to the Army for instructions, they were teaching themselves how to fight the war. This provides us with one example of the movement away from the hierarchical command-and-control culture towards one that is network-centric.

### **Domain 3      Community Networks**

The concept of community has undergone considerable re-evaluation in the changing, more mobile, 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. In whole sections of society neighbourhood support groups have disappeared and people are looking to their replacements on the Internet where web-based communities are not limited by location.

We are studying this phenomenon of emergent online community formation in our research (see for example Hasan & Crawford 2003a,b) to complement the work we are doing in large bureaucracies which are attempting to become more network-centric. Many of the latter are seeking to emulate the formation of communities of practice that happen naturally in civil society. We approach this as both a social and a technical issue, indeed an inexorable interconnection of both aspects in a socio-technical system. 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 (see: [www.eviva.com.au](http://www.eviva.com.au)) has evolved throughout the research to support the purposeful activities of a wide variety of communities. Eviva is a web-based system that has been designed as a shared virtual space with tools that enable collaboration, co-evolution, co-invention, and communication (Hasan & Crawford 2006). 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. Our research approach has been to provide our online tool and knowledge of community behaviour to actively set up and observe communities that could not afford their own technology. The first of these involved a community set up to promote awareness of new technologies (photonics) among the wider public through the activities of scientists with high school students. In these projects, subject-matter experts, students, teachers, parents, technologists and business people contributed to the community activity through:

- Initial 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.
- Community celebrations where young people show their creative work and explain their new learning and interest to members of the community including politicians, local government officials and the media.

This experience was subsequently encapsulated in a socio-technical model, which was used to support a number of work/learning communities as case studies to provide data for the research. The model begins with a face-to-face workshop followed by a period online where learners, experts and instructors are linked. During this period the community of workers and learners undertake a self selected 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.

The key issues emerging from our research in community settings were:

- A shared and inspirational project goal is an essential aspect of any truly collaborative project and essential for active online participation
- The online system enabled convenient boundary crossing between groups who would not usually interact as team members
- The workshops and meetings were an essential complement to online interaction
- Experience of working in teams in collaborative and inclusive ways generates very high levels of voluntary participation and commitment and greater awareness of the benefits of collaborative team work

- A limiting factor for older members of the community is their inexperience of and lack of capability in navigating and strategically using networked interactive communication tools
- The complexity of coordinating, leading and inspiring creative team units is an area for further study. The Eviva system enables operational coordination among people who are not co-located and supports boundaries as these are required. However, the creation and maintenance of attractors that inspire meaningful participation appears to rest firmly in the social domain and depends on relationships, respect and shared understandings.

The most important thing learned from the project 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. The design of the system and the socio-technical methods used to involve people in projects evolved from our wider research. In the culture of many organizations, people have struggled to even imagine working in this way where the tool enables meaningful group coordination and provides evident (and thereby safe) boundaries for teams. Successful project teams also benefited from effective and flexible leadership processes. There appears to be a natural tendency for people to work in a network-centric way when there is a purpose, and support, to do so.

This research is continuing, taking a developmental approach to the social and technical support for work and learning in diverse communities (see Connery & Hasan 2005; Hasan & Crawford 2006). Applying the concepts of situated activity, together with collaboration we see these communities demonstrating, many of the attributes of third generation KM where there is a natural organic network-centric configuration consistent with a knowledge ecosystem. The challenge with these communities, many run by volunteers, is that, although they

have a common focus and purpose, they are often ad hoc and lack the efficiency that comes with the structure of a formal organization. Despite the capability of online technology to support these communities, there is still a need to evolve human and social processes to sustain them.

#### **Domain 4        The Authors' Distributed Research Team**

The authors of this paper are members of a collaborative research team and have been working together for the past seven years. They are located in a variety of research institutions in different cities and use a combination of online applications and serendipitous meetings at conferences to support their collaborative activities. The nature of knowledge production and use has long been a topic of debate and academic research and this now needs to take into account the socio-technical nature of distributed research teams such as ours.

In Australia, research has been largely a publicly funded activity, and the Federal Government is now casting an increasingly critical eye over the way it is currently performed and evaluated. A series of Government moves are promoting inter-disciplinary research that aims to create and apply knowledge to address problems of national significance. This moves use from research where problems are set and solved in a context governed by the interests of a largely academic community (Mode 1 according to Batherham (2003)) to research where knowledge production is carried out within the context of application (Mode 2). It is intended to be useful to someone other than specifically the practitioner, be this industry, government or society generally; and this requirement is present from the beginning. Batterham (2003) describes Mode 1 as “discipline based; distinguishes between theoretical core and its conversion to application” while Mode 2 is “multidisciplinary, team based; constant flow between basic & applied; discovery occurs where knowledge is developed and put to use”. The latter is a relevant description of our research approach. Applying the concepts of situated

activity, we see ourselves as an emergent community of practice, engaging in dynamic purposeful activity and collaborating in an evolving socio-technical system; in other words a model of the network-centric paradigm.

### **The Picture Across these Domains**

Table 1 attempts to interpret the activity situated in each of the domains presented here. This is not intended to be comprehensive but rather paint a picture of the diversity of complex organizational scenarios that co-exist in a rapidly changing world. Taking the unordered perspective from the Cynefin complexity model of Figure 1, the picture reveals unexpected and contradictory emergent patterns. Universities, nominally bastions of knowledge, have the least flexible processes and structures. The military, once reliant on centralised command and control are now, enabled by technology, seeking to adopt more network-centric ways of working while retaining formal structures essential to co-ordinated operations. Communities in civil society, and to an extent our research group, have readily adopted new web-based ways of working and communicating to carry out meaningful activities with a common purpose outside traditional organizational constraints. These networks have many of the knowledge sharing cooperative characteristics desired by organizations. However while some communities thrive, many are not sustained, possibly because they lack the systemic knowledge management capability of a formal organization.

**[Table 1 about here]**

### **Conclusion: Towards the Network Centric Paradigm**

It can be argued that in post-industrial societies change is commonplace rather than the exception and recent years have witnessed a rapid increase in the pace of change. Our case studies illustrate how organizations respond differently to this unstable environment. In order to prosper we ideally need to make sense of the changing world in a way that is coherent and

holistic. Interest in KM has grown in response to this need and has evolved through what Snowden (2002) names a series of three generations, until, in the third, this interest acknowledges the inherent complexity of contemporary organizations and approaches KM in the context of Complexity Theory. A framework is required where there is integration of diverse views with a conceptual, philosophical and pragmatic understanding of the bonds that bind the various components of an organizational system together. The knowledge ecosystem of the Australian KM Standard sets the basis for such a framework where dynamically interrelated elements permit the emergence of meaningful patterns in an unordered environment. This leads us into the concept of a network-centric configuration in which workers leverage information through the collaborative efforts of small and agile self-directed teams (Warne, Ali et al 2005). The capability to do this emanates from rapid developments of information and communications technologies which are driving and supporting the change from the industrial to the information age. The network-centric environment implies new ways of working, with consequences for the organization's infrastructure, processes, people and culture. One of the most challenging aspects of the network-centric paradigm is the need to moderate the organizational culture from one determined by a command and control, rule-based hierarchy to one which supports loosely-coupled, self-managed teams to make cooperative decisions through the sharing of knowledge.

One central limitation of traditional organizational frameworks is the life time of information is assumed to be long. Traditional information systems are designed on the assumption that storage and accessibility mean that approved information will eventually be used. The challenge we now face is that the value and life of information has been reduced by emerging practices and the convergence of information and communication technologies. In networked environments ongoing decision making involves sharing, analysing, critical debate and negotiated transformation of meaning according to changing elements in the situation. In

such a setting diversity and dissent are strengths that ensure that the scope of the decision making process is sufficient for the complexity of the context. Furthermore it ensures that all participants actively evaluate the quality of the information and interaction available as they make shared decisions about operational outcomes. In contrast, formal decision making processes, conducted in a hierarchical organization are often badly informed by out of date, or incomplete, or overwhelming amounts of information in organizational systems and cannot be made at a tempo that is fast enough for effective adaptation to rapid change. The result is a lack of coherence between the slow moving IT infrastructure, and related formal decision making processes, and the more ephemeral, ever changing and emergent shared needs and priorities of day to day human activity.

While technology is not the only or even the most important component of the network-centric paradigm, its constant evolution is providing tools for collaboration, independence and self organization that outstrip the pace of change possible in large monolithic organizations. Old technology (Enterprise Resource Planning (ERP) systems, databases, transaction processing) crystallised the centralised and hierarchical command structures with bureaucratic controls. New technologies (web-based communications and applications) enable anyone to set up a global virtual community or a business bypassing many traditional regulations, processes and structures. New group support, blogs, and wikis, readily taken up in civil society, could support the agility large enterprises need to adapt to change, but this requires a new paradigm.

Similarly, traditional organizational structures assume fixed roles and responsibilities over a long period. In many cases decision makers are not actually responsible for fashioning the operational response. In rapidly changing situations requiring creative and speedy adaptation, informal management roles must change according to the emergent demands of the situation.

Management in networks is defined more holistically by the ability to grasp the complexity and changing demands of the situation and engender effective responses among participants. Networked knowledge management can be described in terms of varying connections and relationships between different agents according to the constraints and opportunities of the emergent context. Leadership and governance in such a context are not defined in terms of organizational authority or capital but in terms of capabilities to catalyse and monitor effective responses among the participants.

The network centric paradigm is a return to a recognition of the reality and value of human relationships, commitment, engagement and purpose, as the driving forces behind shared endeavour in any community. In such a model the different histories, capabilities, needs and purposes of participants and the quality of their relationships and shared interaction define the scope and possibilities for effective shared activity. This is aligned with Snowden's notions of the third generation of KM which involves a sense-making model of collective knowledge creation, disruption and utilisation that allows us to work in both the ordered and unordered quadrant of the Cynefin model. The need for this hybrid model emerges from our case studies. Ordered first generation KM in a traditional hierarchical bureaucracy is stifling growth and organizational learning. Information community networks exists in the unordered space but can fail due to lack of order. Third generation KM is consistent with organic network-centric configurations within a knowledge eco-system perspective. However, as shown by the military case, it may have to exist along-side, or within, large ordered organizations that may retain some hierarchical command and control. Third generation knowledge management moves organizations to the network-centric paradigm.

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	<b>University</b>	<b>Military</b>	<b>Community</b>	<b>Research Team</b>
<b>Where do you fit in?</b> identity, values, power.	Disillusioned. Power shift from academia to business, loss of professional identity	Tensions between technology and people are starting to be addressed, changing values and changing paradigms of power	Ubiquitous use of Web-based communications across space and time, gaining power	Outside some institutional power pressures, peer support
<b>What are you trying to achieve?</b> purpose(s) priorities, commitment.	Market based, Customer focussed	Learning organization, effective operational capability	Focussing on community and global issues	Quality research with application to practice
<b>How do you work?</b> structure, context communication, production processes. Technologies.	Structured, accountable, performance indicators, rigid systems	Technology focussed with people awareness, C2 and with some team autonomy	Unstructured, flexible, networked, project/activity based	Unstructured, networked with constraints from member's institutional context
<b>Trends.</b>	Slow to change, becoming increasingly outmoded in many cases	Hybrid of traditional hierarch and network-centric	Self-organizing and networked with the need for new ways of managing for sustainability	More recognition of this mode of working

Table 1 A summary of the case studies in terms of situated activity

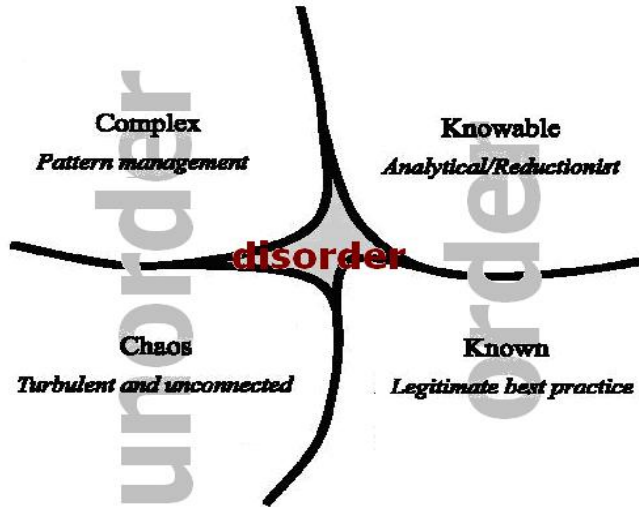


Figure 1: The sense-making Cynefin framework (Snowden 2002).



Figure 2 A visualisation of the Knowledge Eco-System from the Australian KM Standard (AS 5037—2005)