
Complex acts of knowing: paradox and descriptive self-awareness

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Keywords

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Abstract

We are reaching the end of the second generation of knowledge management, with its focus on tacit-explicit knowledge conversion. Triggered by the SECI model of Nonaka, it replaced a first generation focus on timely information provision for decision support and in support of BPR initiatives. Like BPR it has substantially failed to deliver on its promised benefits. The third generation requires the clear separation of context, narrative and content management and challenges the orthodoxy of scientific management. Complex adaptive systems theory is used to create a sense-making model that utilises self-organising capabilities of the informal communities and identifies a natural flow model of knowledge creation, disruption and utilisation. However, the argument from nature of many complexity thinkers is rejected given the human capability to create order and predictability through collective and individual acts of freewill. Knowledge is seen paradoxically, as both a thing and a flow requiring diverse management approaches.

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Introduction

The contention of this paper is that we are entering a third age in the management of knowledge. Further, that the conceptual changes required for both academics and management are substantial, effectively bounding or restricting over a 100 years of management science in a similar way to the bounding of Newtonian science by the discoveries and conceptual insights of quantum mechanics *et al.* in the middle of the last century. These changes are not incremental, but require a phase shift in thinking that appears problematic, but once made reveals a new simplicity without the simplistic and formulaic solutions of too much practice in this domain. A historical equivalent is the phase shift from the domination of dogma in the late medieval period, to the enlightenment; moving from esoteric complication to a new simplicity based on a new understanding of the nature of meaning.

The first age: information for decision support

The first age, prior to 1995, sees knowledge being managed, but the word itself is not problematic, the focus is on the appropriate structuring and flow of information to decision makers and the computerisation of major business applications leading to a technology enabled revolution dominated by the perceived efficiencies of process reengineering. For many, reengineering was carried out with missionary enthusiasm as managers and consultants rode roughshod across pre-existing "primitive" cultures with the intent of enrichment and enlightenment that too frequently degenerated into rape and pillage. By the mid to late-1990s a degree of disillusionment was creeping in, organisations were starting to recognise that they might have achieved efficiencies at the cost of

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effectiveness, they had laid off people with experience or natural talents, vital to their operation, of which they had been unaware. This is aptly summarised by a quote from Hammer and Champy (1993), the archpriests of reengineering: "How people and companies did things yesterday doesn't matter to the business reengineer". The failure to recognise the value of knowledge gained through experience, through traditional forms of knowledge transfer such as apprentice schemes and the collective nature of much knowledge, was such that the word knowledge became problematic.

1995: the transition to the second age

To all intents and purposes, knowledge management started circa 1995 with the popularisation of the SECI model (Nonaka and Takeuchi, 1995) with its focus on the movement of knowledge between tacit and explicit states through the four processes of socialisation, externalisation, combination and internalisation. The concept of tacit and explicit knowledge was not new; its roots in the recent past derive from Polanyi (1974). However, where Polanyi saw tacit and explicit as different but inseparable aspects of knowledge, the *de facto* use of the SECI model was dualistic, rather than dialectical. The SECI model had been published four years earlier (Nonaka, 1991) but without the same impact, for three reasons:

- (1) In 1991 process reengineering was still in full flow, by 1995 its failures in respect of capturing knowledge were becoming more obvious.
- (2) By 1995 collaborative computing, increasing access to e-mail and the growth in intra and extranets were becoming commonplace.
- (3) Early success stories from organisations such as Buckman, Dow, Scandia and others were making the practice of knowledge management more respectable.

An irony is that Nonaka and Takeuchi were only seeking to contrast a claimed Japanese tradition of "Oneness" with a rational, analytical and Cartesian western tradition. Their work derived in the main from the study of innovation in manufacturing processes where tacit knowledge is rendered

explicit *to the degree necessary to enable that process to take place*; it did not follow that all of the knowledge in the designers' heads and conversations had, should or could have been made explicit. In partial contrast, early knowledge programmes attempted to disembodify all knowledge from its possessors to make it an organisational asset. Nonaka attempted to restate his more holistic and dialectical view of tacit and explicit knowledge when he republished the model utilising the Japanese word *Ba*, which is a "shared space for emerging relationships" (Nonaka and Konno, 1998), but by this time the simple two by two of the SECI model was too well established in business plans, software brochures and the structured methods of consultants to be restored to its original intent.

The paradoxical nature of knowledge

Some of the basic concepts underpinning knowledge management are now being challenged:

Knowledge is not a "thing", or a system, but an ephemeral, active process of relating. If one takes this view then no one, let alone a corporation, can own knowledge. Knowledge itself cannot be stored, nor can intellectual capital be measured, and certainly neither of them can be managed (Stacy, 2001).

For all that, this extreme position does bring out that mainstream theory and practice have adopted a Kantian epistemology in which knowledge is perceived as a thing, something absolute, awaiting discovery through scientific investigation.

Stacy accurately summarises many of the deficiencies of mainstream thinking, and is one of a growing group of authors who base their ideas in the science of complex adaptive systems. That new understanding does not require abandonment of much of which has been valuable, but it does involve a recognition that most knowledge management in the post-1995 period has been to all intents and purposes content management. In the third generation we grow beyond managing knowledge as a thing to also managing knowledge as a flow. To do this we will need to focus more on context and narrative, than on content.

The question of the manageability of knowledge is not just an academic one.

Organisations have increasingly discovered that the tacit and explicit distinction tends to focus on the container, rather than the thing contained (Snowden, 2000a). Three heuristics illustrate the change in thinking required to manage knowledge:

- (1) *Knowledge can only be volunteered; it cannot be conscripted.* For the very simple reason that I can never truly know if someone is using his or her knowledge. I can know they have complied with a process or a quality standard. But, we have trained managers to manage conscripts not volunteers.
- (2) *We can always know more than we can tell, and we will always tell more than we can write down.* The nature of knowledge is such that we always know, or are capable of knowing more than we have the physical time or the conceptual ability to say. I can speak in five minutes what it will otherwise take me two weeks to get round to spending a couple of hours writing it down. The process of writing something down is reflective knowledge; it involves both adding and taking away from the actual experience or original thought. Reflective knowledge has high value, but is time consuming and involves loss of control over its subsequent use.
- (3) *We only know what we know when we need to know it.* Human knowledge is deeply contextual, it is triggered by circumstance. In understanding what people know we have to recreate the context of their knowing if we are to ask a meaningful question or enable knowledge use. To ask someone what he or she knows is to ask a meaningless question in a meaningless context, but such approaches are at the heart of mainstream consultancy method.

The three heuristics partially support Stacy's view of knowledge as an "active process of relating" (Stacy, 2001). However, it does not follow that we have to abandon second-generation practice, but we must recognise its limitations. We can encompass both Stacy and Nonaka if we embrace paradox. Philosophers have long seen paradox as a means of creating new knowledge and understanding. Physicists breaking out of the Newtonian era had to accept that electrons are paradoxically both waves and particles: if you look for waves you see waves, if you look

for particles you see particles. Properly understood knowledge is paradoxically both a *thing* and a *flow*; in the second age we looked for things and in consequence found things, in the third age we look for both in different ways and embrace the consequent paradox.

Context: the dimension of abstraction

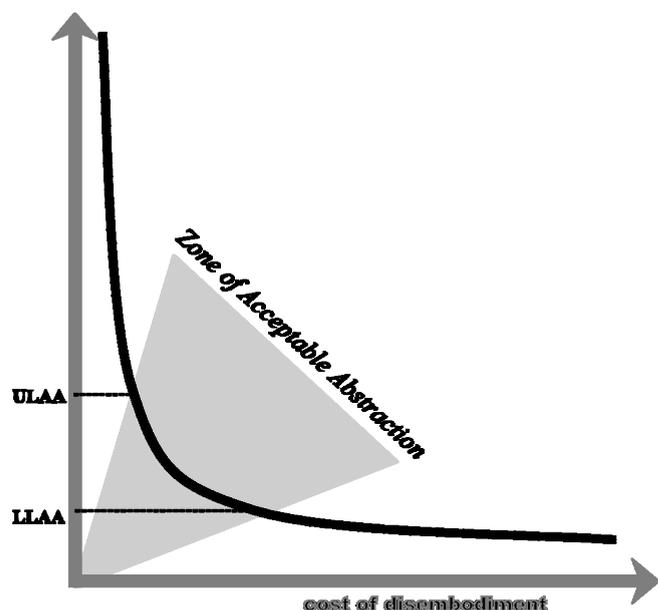
The issue of content and context, which runs through all three heuristics, is key to understanding the nature of knowledge transfer. To illustrate this we can look at three situations in which expert knowledge is sought:

- (1) A colleague with whom they have worked for several years asks a question, a brief exchange takes place in the context of common experience and trust and knowledge is transferred.
- (2) A colleague who is not known to the expert asks the same question. The discourse is now more extensive as it will take longer to create a common context, and when knowledge transfer takes place it is conditional: "phone me if this happens" or "lets talk again when you complete that stage" are common statements.
- (3) The expert is asked to codify their knowledge in anticipation of potential future uses of that knowledge. Assuming willingness to volunteer, the process of creating shared context requires the expert to write a book.

Each level operates at a different level of abstraction, both implicit and explicit. Figure 1 contrasts the level of abstraction with the cost of disembodiment, most frequently the cost of codification. The model was originally inspired by the I-Space (Boisot, 1998). High abstraction either involves expert language, taught in universities, though books, training programmes, etc., or shared experiential and cultural referents.

At the highest level of abstraction, where I share knowledge with myself there is a minor cost; I may keep notes but no one else has to read them. On the other hand, if I want to share with everyone the cost becomes infinite, as the audience not only needs to share the same language, but also the same education, experience, values, etc. In practice there is a very narrow zone between the lower and

Figure 1 Levels of acceptable abstraction



upper levels of acceptable abstraction in any knowledge exchange. Expert communities resent any knowledge below the lower level as it involves reengaging in a level of conversation which they have passed some time ago: they will visit to teach, but not to collaborate. In contrast, a broad cross organisation community needs to ensure that it does not exceed the upper level; the lower level is of less importance. The upper and lower levels represent the range of shared context and therefore the range of possible knowledge flow.

Context: the dimension of culture

Abstraction is one dimension of context; the other is culture. Keesing and Strathern (1998) assert two very different ways in which the term culture is used:

- (1) The socio-cultural system or the pattern of residence and resource exploitation that can be observed directly, documented and measured in a fairly straightforward manner. The tools and other artefacts that we use to create communities, the virtual environment we create and the way we create, distribute and utilise assets within the community. These are teaching cultures that are aware of the knowledge that needs to be transferred to the next generation and which create training programmes. They

are characterised by their certainty or explicit knowability.

- (2) Culture as an " . . . ideational system. Cultures in this sense comprise systems of shared ideas, systems of concepts and rules and meanings that underlie and are expressed in the ways that humans live. Culture, so defined, refers to what humans learn, not what they do and make" (Keesing and Strathern, 1998). This is also the way in which humans provide "standards for deciding what is . . . for deciding what can be . . . for deciding how one feels about it . . . for deciding what to do about it, and . . . for deciding how to go about doing it" (Goodenough, 1961). Such cultures are tacit in nature: networked, tribal and fluid. They are learning cultures because they deal with ambiguity and uncertainty originating in the environment, or self generated for innovative purposes.

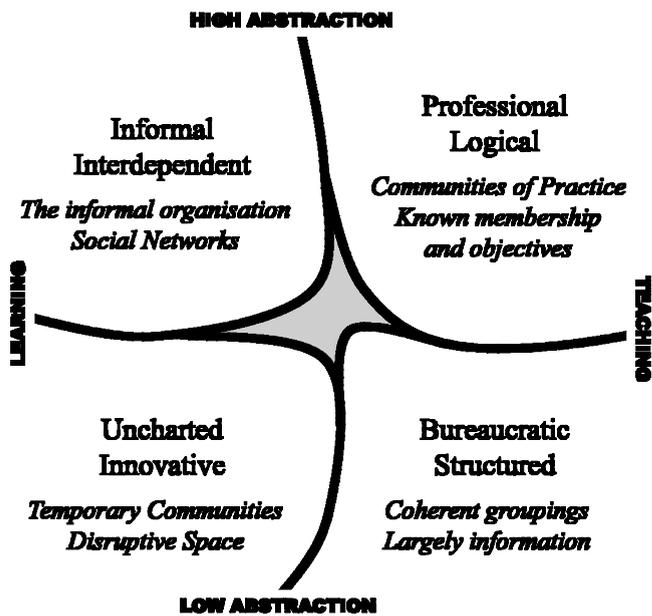
Both cultures are key to the flow of knowledge within an organisation. We need to transfer to new members, in both society and the organisation, knowledge that has been painfully created at cost over previous generations. The mechanisms for learning are very different from those for teaching. In the case of teaching there is little ambiguity between teacher and taught, in learning such ambiguity is often a necessary precondition of innovation. The costs and scalability are also different, in the case of teaching the population of students can be large, varying to some degree with the level of abstraction; reliability, scalability and economies of scale are both realistic and sensible. Learning is more about providing space and time for new meaning to emerge, research facilities are not cheap and not all employees can realistically be provided with space of learning, as opposed to the application of what can be taught.

Cynefin: diversity over time and space

The dimensions of abstraction and culture create the sense-making model, shown in Figure 2.

Cynefin (pronounced kun-ev'in) is a Welsh word with no direct equivalent in English. As a noun it is translated as habitat, as an adjective acquainted or familiar, but

Figure 2 Cynefin: common sense making



dictionary definitions fail to do it justice. A more poetic, definition comes from the introduction to a collection of paintings by Kyffin Williams, a distinctively Welsh artist whose use of oils creates a new awareness of the mountains of his native land and their relationship to the spirituality of its people:

It describes that relationship: the place of your birth and of your upbringing, the environment in which you live and to which you are naturally acclimatised (Sinclair, 1998).

It differs from Nonaka's concept of *Ba*, in that it links a community into its shared history – or histories – in a way that paradoxically both limits the perception of that community while enabling an instinctive and intuitive ability to adapt to conditions of profound uncertainty. In general, if a community is not physically, temporally and spiritually rooted, then it is alienated from its environment and will focus on survival rather than creativity and collaboration. In such conditions, knowledge hoarding will predominate and the community will close itself to the external world. If the alienation becomes extreme, the community may even turn in on itself, atomising into an incoherent babble of competing self interests. Critically it emphasises that we never start from a zero base when we design a knowledge system, all players in that system come with the baggage, positive and negative derived from multiple histories.

Cynefin creates four open spaces or domains of knowledge all of which have validity within different contexts. They are domains not quadrants as they create boundaries within a centre of focus, but they do not pretend to fully encompass all possibilities. The fifth central space has significance, but is beyond the scope of this paper.

Bureaucratic/structured: teaching, low abstraction

This is the formal organisation, the realm of company policy, procedures and controls. It is a training environment. Its language is known, explicit and open. It is the legitimate domain of the corporate intranet and its shared context is the lowest common denominator of its target audience's shared context.

Professional/logical: teaching, high abstraction

Commonly professional individuals who, through defined training programmes, acquire a specialist terminology; codified in textbooks. The high level of abstraction is teachable given the necessary time, intelligence and opportunity. This is one of the most important domains as knowledge communication is at its most efficient due to the high level of abstraction; in second generation thinking this is the domain of communities of practice.

Informal/interdependent: learning, high abstraction

In this domain, we have the abstraction of shared experiences, values and beliefs. This is the domain of the shadow or informal organisation, that complex network of obligations, experiences and mutual commitments without which an organisation could not survive. Trust in this domain is a naturally occurring phenomenon as all collaboration is voluntary in nature. Examinations of primitive symbolic or pictorial languages reveal some relevant facts. Primary of among these is the ability of symbolic languages to convey a large amount of knowledge or information in a very succinct way. Each symbol has a different meaning according the combination of symbols that preceded it. The problem is that such languages are difficult to comprehend and near impossible to use unless you grow up in

the community of symbol users. In some primitive societies the symbols are stories, often unique to a particular family who train their children to act as human repositories of complex stories that contain the wisdom of the tribe. The ability to convey high levels of complexity through story lies in the highly abstract nature of the symbol associations in the observer's mind when he/she hears the story. It triggers ideas, concepts, values and beliefs at an emotional and intellectual level simultaneously. A critical mass of such anecdotal material from a cohesive community can be used to identify and codify simple rules and values that underlie the reality of that organisation's culture (Snowden, 1999b). At its simplest manifestation this can be a coded reference to past experience. "You're doing a Margi" may be praise or blame – without context the phrase is meaningless, with context a dense set of experiences is communicated in a simple form. It is the common understanding of the symbol structure and its sequence that provides shared context in this domain.

Uncharted/innovative: learning, low abstraction

We now reach a domain in which we have neither the experience, nor the expertise, because the situation is new, the ultimate learning environment. The organisation will tend to look at such problems through the filters of past experience. The history of business is littered with companies which failed to realise that the world had changed. In hindsight such foolishness is easy to identify, but at the time the dominant language and belief systems of the organisation concerned make it far from obvious. This is particularly true where the cost of knowledge creation within the organisation is high as this tends to knowledge hoarding and secrecy that in turn can blind the organisation to new and changed circumstances. Other organisations deliberately share knowledge, depending on speed of exploitation as the means of maintaining competitive advantage (Boisot, 1998). Here we act to create context to enable action, through individuals or communities who have either developed specific understanding, or who are comfortable in conditions of extreme uncertainty. Such individuals or communities impose patterns

on chaos to make it both comprehensible and manageable.

The third age: complicated, complex and chaotic

The above description of the Cynefin model relates to its use in the context of communities, and it originally developed from a study of actual, as opposed to stated knowledge management practice in IBM (Snowden, 1999a) but has since been validated in other organisations and applied to strategy, innovation, culture, trust and communication. It is based on an understanding of the distinctiveness of three different types of system: complicated, complex and chaotic, best understood through two distinctions.

The first distinction is that between complex and complicated. An aircraft is a complicated system; all of its thousands of components are knowable, definable and capable of being catalogued as are all of the relationships between those components. If necessary it can be taken apart and examined to discover the nature of the components and their relationships. Cause and effect can be separated and by understanding their linkages we can control outcomes.

Human systems are complex; a complex system comprises many interacting agents, an agent being anything that has identity. We all exist in many identities; the author can be son, father or bother in different contexts; similarly with work group identities, both formal and informal along with various social groupings. As we fluidly move among identities, we observe different rules, rituals, and procedures unconsciously. In such a complex system, the components and their interactions are changing and can never be quite pinned down. The system is irreducible. Cause and effect cannot be separated because they are intimately intertwined (Juarrero, 1999).

Two examples make this clearer:

- (1) Consider what happens in an organisation when a rumour of reorganisation surfaces: the complex human system starts to mutate and change in unknowable ways; new patterns form in anticipation of the event. On the other hand, if you walk up to an aircraft with a box of tools in your hand, nothing changes.

- (2) A feature of a complex system is the phenomenon of retrospective coherence in which the current state of affairs always makes logical sense, but only when we look backwards. The current pattern is logical, but is only one of many patterns that could have formed, any one of which would be equally logical.

Organisations tend to study past events to create predictive and prescriptive models for future decisions based on the assumption that they are dealing with a complicated system in which the components and associated relationships are capable of discovery and management. This arises from Taylor's application, over 100 years ago, of the conceptual models of Newtonian physics to management theory in the principles of scientific management. Subsequently, a whole industry has been built between business schools and consultancies in which generalised models are created from analytical study of multiple case histories. Scientific management served well in the revolutions of total quality management and business process reengineering and continues to be applicable in the domain of the complicated; however, just as Newtonian physics was bounded by the understandings of quantum mechanics so scientific management has been bounded by the need to manage knowledge and learning.

The second distinction is between a complex system comprising many interacting identities in which, while I cannot distinguish cause and effect relationships I can identify and influence patterns of interactivity, with a chaotic system in which all connections have broken down and we are in a state of turbulence or eternal boiling. It is dangerous, as too many writers do, to confuse complex with chaotic. In a complex domain we manage to recognise, disrupt, reinforce and seed the emergence of patterns; we allow the interaction of identities to create coherence and meaning. In a chaotic domain no such patterns are possible unless we intervene to impose them; they will not emerge through the interaction of agents.

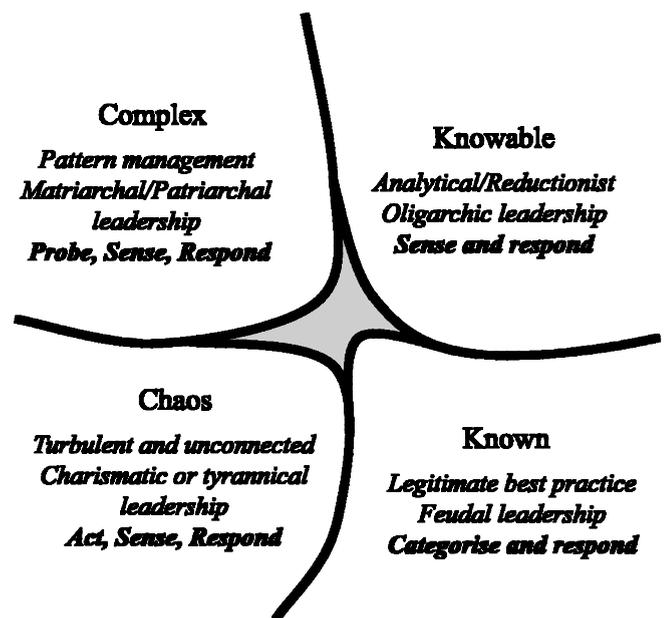
The three types of system map on to the Cynefin model, with a separation of complicated systems into those in which we know all of the cause and effect relationships and those that are knowable if we had the resource, capability and time. This is

illustrated in Figure 3. Each of the domains contains a different model of community behaviour; each requires a different form of management and a different leadership style.

Known space is the only legitimate domain of best practice. Within known limits we can both predict and prescribe behaviour. Humans, acting collectively, can make systems that might otherwise be complex or chaotic into known systems; we impose order through laws and practices that have sufficient universal acceptance to create predictable environments. Too many thinkers in complexity take models from insect behaviour and attempt to impose them onto human interactions: while humans often behave like ants they are capable of far more, they can direct, structure and limit inter-activity to make it predictable. Such activity is not only desirable, but also essential in a modern organisation or society which provides a predictable framework for employees and citizens. On the negative side, the imposed structure can continue beyond its useful life. In this domain we categorise incoming stimulus, and once categorised we respond in accordance with predefined procedures. Leadership tends to a feudal model, with budget having replaced land as the controlling mechanism.

Knowable space is the domain of good practice. We do not yet know all the linkages, but they can be discovered. This is the domain of experts, whose expertise enables us to manage by delegation without the need for

Figure 3 Cynefin: decision making



categorisation. Again there is a human imposition of order but it is more fluid than in the space of the known. A major issue in the space of the knowable is entrainment of thinking. There are many examples in history of a refusal by established experts to accept new thinking: the trial of Galileo, the 30-year rejection of clocks as a means of measuring longitude, the Maginot line in the Second World War, the list is endless. The very thing that enables expertise to develop, namely, the codification of expert language in turn leads inevitably to entrainment of thinking. Exhortations to remain open to new ideas are unlikely to succeed. Management of this space requires the cyclical disruption of perceived wisdom. The common context of expertise is both an enabler and blocker to knowledge creation and from time to time context must be removed to allow the emergence of new meaning. In this space we sense and respond based on our expert understanding of the situation, the leadership models are oligarchic requiring consent of the elders of the community and interestingly oligarchies are often less innovative than the idiosyncrasies of feudalism.

The nature of the complex domain is the management of patterns. We need to identify the early signs of a pattern forming and disrupt those we find undesirable while stabilising those we want. If we are really clever then we seed the space to encourage the formation of patterns that we can control. These patterns are, to use the language of complex adaptive systems theory, emergent properties of the interactions of the various agents. By increasing information flow, variety and connectiveness either singly or in combination, we can break down existing patterns and create the conditions under which new patterns will emerge, although the nature of emergence is not predictable. This is fluid space of varying stabilities over time and space. Most humans make decisions on the basis of past or perceived future patterns not through rational choices between alternatives (Klein, 1998), an understanding of patterns is, therefore, key to managing behaviour within organisations and in relationship to markets and environmental factors. In a complex space we cannot sense and respond, but must first probe the space to stimulate pattern understanding or formation, then sense the patterns and respond accordingly. Entrepreneurs manage in this space

instinctively while large organisations find it more uncomfortable. In this domain leadership cannot be imposed, it is emergent based on natural authority and respect but it is not democratic, it is matriarchal or patriarchal.

Chaos represents the consequence of excessive structure or massive change, both of which can cause linkages to sunder. As such it is a space that requires crisis management and is not comfortable, or entered with any enthusiasm by other than the insane. However, it is one of the most useful spaces, and one that needs to be actively managed. It provides a means by which entrainment of thinking, the inevitable consequence of expertise can be disrupted by breaking down the assumptions on which that expertise is based. It is also a space into which most management teams and all knowledge programmes will be precipitated; regular immersion in a controlled way can immunise the organisation and create patterns of behaviour that will pay dividends when markets create those conditions. We also need to remember that what to one organisation is chaotic, to another is complex or knowable. In the chaotic domain the most important thing is to act, then we can sense and respond. Leadership, this domain is about power: either the power of tyranny, or that of charisma. Both models impose order, and if order is imposed without loss of control, then the new space is capable of being used to advantage.

The knowledge spiral and Cynefin

The purpose of the Cynefin model is to enable sense making by increasing the awareness of borders and triggering with a border transition a different model of decision making, leadership or community. It argues strongly against single or idealised models, instead focusing on diversity as the key to adaptability. The law of requisite variety is well understood in ecology; if the diversity of species falls below a certain level then the ecology stagnates and dies. Excessive focus on core competence, a single model of community of practice or a common investment appraisal process are all examples of ways in which organisations can destroy requisite variety. It has always amused the author to see the amount of work in large

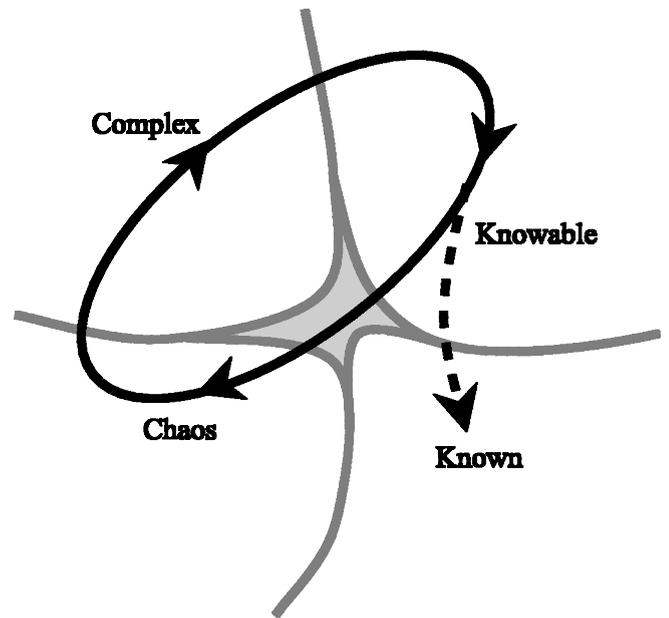
organisations that goes into making the system work once a decision had been made, without any consideration being entertained that the system itself should be changed to accommodate what is common sense to those involved. It also creates a sub-class of people who add no value to the organisation, but are skilled in its arcane workings and without whose co-operation nothing happens.

Nonaka and his various co-authors see knowledge creation as a spiral of SECI resulting in the progressive transfer of knowledge from individual, to group, to organisation and beyond. This is a clear view of knowledge as a thing to be managed; that at some stage in its life cycle will be explicit. Earlier an explicitly contradictory model was identified in which knowledge was seen as an "ephemeral, active process of relating" (Stacy, 2001). We also suggested that this was not a contradiction but a paradox in which knowledge is simultaneously and paradoxically both a thing and a flow. The Cynefin model allows us to see knowledge in both its aspects and this allows us to continue to use the insights and practices of scientific management, while embracing the new learnings and insights from the new sciences of complexity and chaos. Cynefin focuses on creating the conditions for the emergence of meaning: in its two complicated domains these are rationalist and reductionist: the SECI model works. In the complex and chaotic domains new science and new approaches are required. The range of possible flows within the Cynefin model across its various boundary transformations is large and has been partially described elsewhere (Snowden, 2000b), here we will look at an idealised model of knowledge flow involving three key boundary transitions: the disruption of entrained thinking, the creation and stimulation of informal communities and the just-in-time transfer of knowledge from informal to formal. These transitions are shown in Figure 4.

Just-in-time knowledge management: from complex to knowable

For many years stock was held on the factory floor in anticipation of need at a high cost and risk of redundancy. Eventually it was realised that this was a mistake and significant levels of stock were pushed back to suppliers entering

Figure 4 Cynefin: knowledge flows



the factory on a just-in-time (JIT) basis, thus minimising costs. Second-generation knowledge management made all the same mistakes. In the third generation we create ecologies in which the informal communities of the complex domain can self organise and self manage their knowledge in such a way as to permit that knowledge to transfer to the formal, knowable domain on a JIT basis.

The sheer number of informal and semi-formal communities within an organisation is too great to permit formal management. In one study within IBM Global Services the ratio between informal and formal communities was in excess of 1,000:1 and that only represents those communities who chose to use virtual collaboration (Snowden, 1999a) so the actual ratio is probably well in excess of this. The informal, complex space contains much knowledge that never needs to be an organisational asset; the issue is that even if we knew what we know, we cannot distinguish in advance what we need to know as an organisation, and critically when we need to know it. Techniques for the informal-formal JIT transfer include:

- Flagging by subject matter. To take an example from the author's own experience, during the early stage of pioneering work on narrative techniques for knowledge disclosure a private collaboration space was created within IBM's network, but not as a part of a formal community of practice. This contained a record of significant mistakes

and associated learning that would only be shared in a small trusted community. The subject matter was flagged in the formal community under the more colloquial label of "organisational story telling". This resulted in an early trickle of e-mails until 1999 when an article on the use of story in 3M was published (Shaw *et al.*, 1998); story telling became fashionable and e-mail volume increased to a painful level. At this point a document answering the most frequently answered questions was written in self-defence. The socialisation pressure of the ecology forced the voluntary codification of knowledge and that same pressure, through the various questions provides the context that allows the production of material at an appropriate level of abstraction. A formal document prepared in advance of those questions would have been far too time consuming to produce and it might also never have been needed: story might have remained an esoteric technique.

- Expertise location systems replace the second-generation technique of yellow pages making connections between people and communities. One example, "tacit" will trawl e-mail records to identify where expertise lies, but allow the individual knowledge holder to determine if his or her expertise is to be public. The knowledge seeker will then be directed to people whose expertise has been made public, but will not gain access to those who desire privacy; in those cases the knowledge holder will be notified that their knowledge is being sought and they have a choice to volunteer. If the person making the request has a reputation for trustworthy behaviour then knowledge will be readily volunteered otherwise they will get no access. Several subtle things have happened here; an existing asset, e-mail discloses what we know; the paradox of privacy is respected, if you allow privacy people will share, if you insist on sharing they will be private; knowledge is requested in such a way that context can be created through conversation; we have ensured that trustworthy behaviour results in better access to knowledge and, thereby, build trust into the ecology of knowledge exchange. All in all we have reduced cost

and increased effectiveness by recognising that we are dealing with a complex not a complicated system.

- We can use the complex domain as a means of creating communities in the formal space. Clustering is the identification of like-minded or like interested individuals within the organisation, who already form the nucleus of a community. Software tools such as affinity mapping and social network analysis (Cross *et al.*, in press) can also serve to identify the natural focal points of a proto-community. Such clusters will have already worked out the upper and lower levels of acceptable abstraction and will have sufficient shared context to create a sustainable, low cost formal community. Swarming is used where no naturally occurring cluster can be found, either to create a cluster, or make one visible. The metaphor of a swarm of bees is appropriate here; if the beekeeper can capture the swarm after it has left the hive, then it can be put in a new hive and will become productive. Swarming involves creating the equivalent of a bright light and seeing what comes to it: a Web discussion group, evening lecture series, an open competition, there are many ways of finding who is interested and will also volunteer. Only if we cannot either find a cluster or a swarm do we build a formal community with all the associated costs of creating something from scratch reserving our financial and time investment for the number of situations where a non-naturalistic intervention is necessary.

Organisations need to realise the degree of their dependence on informal networks. The danger is of chronic self-deception in the formal organisation, partly reinforced by the camouflage behaviour of individuals in conforming to the pseudo-rational models.

A mature organisation will recognise that such informal networks are a major competitive advantage and while ensuring scalability through automated process and formal constructions will leave room for the informal communities to operate.

Disruption: from knowable to chaotic

The second key transition is to provide cyclical disruption of the entrained thinking in expert communities. Exhortations to be open to change and new ideas rarely work. The history of science, ideas and markets proves the contrary; for any radical change revolution resisted by the establishment seems the only way forward. This entrainment of thinking is a variation of the pattern matching nature of decision-making (Klein, 1998) that is a basic feature of human condition and one which in normal circumstances is important.

Perspective shift, when necessary, is not easy to achieve and needs to be handled with care if operational efficiency is to be maintained. However, there are various techniques that do work, taking deep experts in one field and linking them with experts in a radically different field, which will challenge their assumptions, is one. An actual example being the exposure of marketing experts in a retailer to individuals involved in the design of ballistic missile defence systems, combined with pressure and a degree of starvation of resource, critical to creativity powerful results can be obtained (Snowden, 2001). Such disruption does not need to take such an extreme form and is best managed as a ritual and expected process. Often it is sufficient to take the leadership of a community into a chaotic environment, it does not have to be the whole community. The ritual is important; humans manage boundary transitions through rituals that both create awareness of the transition, but equally awareness of the new roles, responsibility and social mores associated with the new space. If the disruption is cyclical and expected, then we are closer to a learning ecology, we have also to some degree immunised the group in respect of involuntary moves into the chaotic space.

Creating new identities and interactions: from chaotic to complex

We use the domain of chaos to disrupt in advance of need, in order to break down inappropriate or over restrictive models, combined with constrained starvation, pressure and access to new concepts and ideas. As a result we create radically new capability within the ecology, which will both transform the knowable domain of experts and stimulate

the creation of new networks, communities and trust/experience relationships. While new alliances and relationships form from the creative stimulus of chaos.

The chaotic space is not of itself the only source of natural communities, new people join the organisation, existing projects create new informal communities and trusted links; the normal day to day interaction of human agents is a constant source of new communities. Chaos is particularly productive, but is not the only source. New thinking in third generation knowledge work is starting to look at social network stimulation as a means to accelerate ten years of social contact to ten months of voluntary activity (Snowden and Kurtz, 2002) and an increasing recognition that JIT requires greater openness to "suppliers" to allow them to optimise supply into the formal system and also accelerate the process.

The natural flow of knowledge

We can now see the sensible pattern of flow of knowledge within an organisation. Communities form naturally in the complex domain, and as a result of activity both voluntary and involuntary within the domain of chaos. JIT techniques, including cluster and swarming allow us to use the complex domain to create, through a process of formalisation, more natural and sustainable communities in the knowable domain. We can also commence operations here, but the cost will be high. A limited amount of codified knowledge can be fully separated from its owners and transferred to the best practice domain, that of the known. On a cyclical basis we disrupt the assumptions and models of the knowable domain of experts allowing new meaning to emerge. From this perspective we see knowledge as flowing between different states, with different rules, expectations and methods of management. We do not have to choose between views and approaches, but we bound those approaches to their appropriate domains. The Cynefin model allows the creation of multiple contexts.

Conclusion

This paper has argued that the focus on tacit-explicit knowledge conversion that has

dominated knowledge management practice since 1995 provides a limited, but useful set of models and tools. The paper rejects both the assumed universality of tacit-explicit conversion and recent arguments that the phrase knowledge management is an oxymoron. This is achieved by embracing the paradoxical nature of knowledge as both a thing and a flow. The basis of the argument is for the adoption of different tools, practices and conceptual understanding of the four spaces of the Cynefin model: known, knowable, complex and chaotic. This model has been made possible by key understandings drawn from the science of complex adaptive systems. However, a key distinction is made between human complex systems, and those that are observed in nature. Humans, acting consciously, or unconsciously are capable of a collective imposition of order in their interactions that enables cause to be separated from effect and predictive and prescriptive models to be built. The mistake of scientific management is to assume that such imposed order is an absolute or universal structure. Its stability and accordingly its usefulness are based on common will and a stable environment. When conditions of uncertainty are reached, the order can break down or artificially persist beyond its usefulness. By implication it is argued that the dogma of scientific management, hypothesis-based consulting and the generalisation of best practice from multi-client or multi-project studies are inhibiting factors in progressing to the new levels of conceptual understanding required in the modern world.

In the new, "complexity informed" but not "complexity constrained" third generation, content, narrative and context management provide a radical synthesis of the concepts and practices of both first and second generation. By enabling descriptive self awareness within an organisation, rather than imposing an pseudo-analytic model of best practice, it provides a new simplicity, without being simplistic, enabling the emergence of new meaning through the interaction of the informal and the formal in a complex ecology of knowledge.

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