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Unordered Business Processes, Sustainability and Green IS

A/Prof Helen Hasan, University of Wollongong

Abstract

Green Information Systems (Green IS) provides a socio-technical perspective on the diverse complex phenomena of organisational sustainability. The Cynefin sense-making framework is eminently suitable for making sense of dynamic, complex phenomena and for guiding sensible decisions on how to meet the challenges they present. The Cynefin framework is described here and illustrated in terms of both ordered and unordered business processes. It is the unordered that are the least understood; but they are the most critical when it comes to sustainability. While order may be appropriate in the short term, sustainability issues also demand a more challenging long-term perspective. Just how rapidly and unpredictably business processes can change is well known in the field of IS which understands the revolutionary nature of new digital technologies. This chapter explores ways to manage sustainably in the face of such uncertainty through an appreciation of unordered complexity.

Introduction

Environmental issues that threaten our very existence have recently captured global public attention through the efforts of Stern (2006), Gore (2006), Shiva (2011) and others. In the face of environmental threats, such as climate change, together with their economic and social consequences, organisational sustainability has become a critical but complex long-term challenge. However, sustainability is a broad concept that has multiple interconnected dimensions and meanings that are not well understood. For a business to be sustainable it should "... meet the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987). This widely-accepted definition implies a balance between short term decision-making with long term aspirations in dealing with an uncertain and unpredictable future. The last few decades have shown how rapidly our ways of doing business can change with an increasing rate of change driven by advances in information and communications technologies (ICT). There is every reason to believe that this trend will continue and take us in directions we can hardly imagine let alone predict. Researchers from many disciplines are investigating the underlying principles of this phenomenon but researchers in the fields of Information Systems (IS), Knowledge Management (KM) and Business Process Management (BPM) have a particular contribution to make within the specialisation of Green IS.

The fields of IS, KM and BPM view the role of ICT in businesses processes from an socio-technical systems perspective and are thus well placed to understand the evolutionary changes have occurred since the introduction of computers.. Experience of technology-driven revolutionary change suggests that sustainability is rarely achieved if all business processes continue to be managed in an ordered and predictable fashion. The unpredictability of the future economic, social and environmental circumstances and their complex interactions, requires an appreciation of diversity and variety among business processes. Two key concepts for sustainability are thus those of requisite variety and of performance according to the Triple Bottom Line (economic, social and environmental). The Law of Requisite Variety (Ashby 1957) tells us that an enterprise will only succeed if it includes in its systems the capability to match the level of complexity and diversity of the context in which it operates. The Triple Bottom Line (Brown et al 2006): implies that long-term sustainability requires a view of business that is more than just making a profit and producing a return on investment.

It requires a view that also recognises the ambiguous and often conflicting demands of the social and environmental responsibilities of business.

Diversity, ambiguity and conflict are usually considered undesirable in an environment that needs to be ordered and so, when situations get complicated, every effort is made to reduce them. In contrast, according to the Law of Requisite Variety together with the demands of the Triple Bottom Line, diversity, ambiguity and conflict cannot, and should not, be eliminated in complex situations. Gray (2009) explains the distinction by saying “when you make the complicated simple, you make it better, but when you make the complex simple, you make it wrong”. As will be explained more fully later, this dichotomy is the focus of the Cynefin sense-making framework (Snowden 2002; Kurtz & Snowden 2003) which was developed for the field of KM as it emerged within the IS community in the 1990s. The KM emphasis on *knowledge* rather than *information* came about with the growing sophistication of ICT-based analysis and decision support systems together with the increased complexity of the business environment as the Internet provided unprecedented global interconnectedness.

In a similar fashion to KM, the field of BPM has emerged from mainstream IS and addresses management and technical aspects of formal business processes. According to its entry in Wikipedia, “BPM enables organisations to be more efficient, more effective and more capable of change than a functionally focused, traditional hierarchical management approach”. Unlike the related field of Business Process Re-engineering (BPR), BPM is more interested in the continuous improve processes and process optimization. As ICT plays an integral role in designing, modelling, optimising and managing business processes BPM has strong link to the more technical end of IS and to Computer Science. However, both BPM and KM are subsets of IS that have a strong industry presence and are well-embedded in current organisational practice. This suggests that the Cynefin framework from KM may be well suited to BPM and, in particular, areas of Green IS related to BPM.

The following section provides an IS perspective on the diverse complex phenomena that are emerging in the 2000s with respect to issues of sustainability. The Cynefin framework is then described and used to make sense of these phenomena. The utility of the framework in making sense of the problems associated with sustainability is illustrated with specific examples of both ordered and unordered business processes. It is the unordered ones that are the least understood; but they are the most critical when it comes to sustainability. A discussion is then presented on the resolution of complex unordered BPM problems. This emphasises the use of ICT-based systems in the complex Domain and indicates how these systems may influence sustainability in an uncertain future.

Background to Green IS and Sustainability BPM

Sustainability is about anticipating the future. However, history has shown us that our predictions about the future have often been quite inaccurate in times of turbulence and change. This has been particularly so in the case of information systems with their rapidly evolving capability, expansive adoption and global impact. Go back ten years and Intranets were quite a novelty. Twenty years ago businesses were only just realising that they needed a presence on the World Wide Web. Thirty years ago few organisations made use of email. Forty years ago only the hobbyists had a personal computer. Few people foresaw the rapidity with which such revolutionary ICT innovations would make us more interconnected, mobile and able to carry out tasks in previously inconceivable ways at any time and in any place. We can only guess at what sort of systems we will have in the next ten, twenty or thirty years and how they will affect the sustainability of human enterprises. What we do know is that change is inevitable and that with the ongoing development of new ICT-based systems what we will

be able to do will continue to grow new business capability.

Researchers in the field of IS have been studying ICT-based systems over the past few decades and have accumulated knowledge of their evolving nature; their impact on individuals, organisations, whole industries and on society at large. They know how ICT-based systems have automated almost all routine operations resulting in huge gains in the efficiency of business processes. Few firms can now function without their computer-based systems and networks. E-commerce has restructured the market place blurring the boundaries between businesses themselves and between a business and its customers. ICT-based systems enable the integration of inter-organisational supply chains, support the running of multinational business with budgets greater than many countries and allow micro-businesses to enter the global market place.

IS research has traditionally focussed on organisational systems and processes although, as we approaching the second decade of the 21st century, topics at IS conferences have broaden into social media, web-based communities, economics of IS, IS for global development and Green IS. This may indicate that most of the issues concerned with basic organisational ICT systems are now reasonably well understood and that the big challenges now facing organisations are ones where new kinds of social-technical systems are needed. Organisational sustainability, with the support of such systems, is the province of Green IS which is defined as “the design and implementation of information systems that contribute to sustainability of business processes” (Boudreau et al 2008).

Green IS is a much broader concept than Green IT which only looks at the Green-House Gas (GHG) emissions from the IT industry itself. A report from the Australian Computer Society (Philipson 2010) contains a breakdown of data on Green IT and provides evidence that current measures are relatively straight forward and obvious, such as server consolidation through virtualisation, devices to shut down equipment not in use, smart metering and optimisation regimes. Most of the Green IT programs being implemented to date are ones that also have cost savings and so are popular with management. These lie in the domain of ordered problems and solutions. The programs that are more difficult to implement are ones where there is an obvious short-term cost or which involve changing the behaviours of people, such as reading from the screen and meeting virtually. This typifies the domain of unordered business problems and solutions as they involved a mix of economic and socio-technical issues where unpredictable human reactions cannot be ignored.

In practice, organisations realise their relationship with their environment and their social responsibilities towards different stakeholders to varying extents. They value the investments of shareholders and the patronage of customers so tend to treat them well for their own self interest. Employees are sometime not so favoured and government regulation is put in place to ensure that they receive fair treatment. Activities of an organisation affect the local environment and the way the relationship with their community is handled can severely affect an organisation’s reputation and ultimately its sustainability. The complex relationship between economical, environmental and social elements is starkly evident when a major industrial environmental disaster occurs. These disasters, which result from organisational negligence or malpractice, negatively affect all three elements of the triple bottom line and lie in the domain of *disordered* problems and solutions.

While the constantly evolving field of IS cannot alone provide a complete roadmap to sustainability, it has the knowledge and skills to deal with challenges that range from simple to complicated and complex. In a landmark paper on Green IS, Watson et al (2010) define an information system as “an integrated and cooperating set of people, processes, software, and information technologies to support individual, organizational, or societal goals”. By

implication the field of IS investigates the design, development, implementation, use and impact of such systems. Watson et al (2010) identify research questions for Green IS scholars, many of which cross the boundaries of what is considered typical IS research. They point out special and urgent nature of problems in the Green space, where IS and BPM researchers can play a key role while embracing a new range of methodologies needed to conduct this research. This call to arms provides the incentive to conduct meaningful research into the viability of more flexible, innovative practices using ICT tools that will enable enterprises to embrace sustainability. In the following section of the chapter I describe how the Cynefin sense-making framework use the distinctions between *order*, *unorder* and *disorder* to match problems, and their contexts, with suitable methods, tools and techniques that lead to solutions.

The Cynefin Framework: Order, Unorder and Disorder

The Cynefin sense-making framework was developed by Dave Snowden when working at IBM (Snowden 2002). At that time, developments of decision support systems, expert systems, data warehousing, and business intelligence were elevating information systems from tools which automated and supported operational business processes to the strategic spheres of the organisation. At that time, KM was emerging as a topic of interest in a number of disciplines such as Human Resources, Computer Science, Organisation Science and IS. Each of these disciplines gave a different emphasis to KM: human, technical or organisational, with IS attempting to incorporate this breadth. The Cynefin framework typified this attempt and has become popular with researchers who want to take a holistic and dynamic view of KM and other related issues.

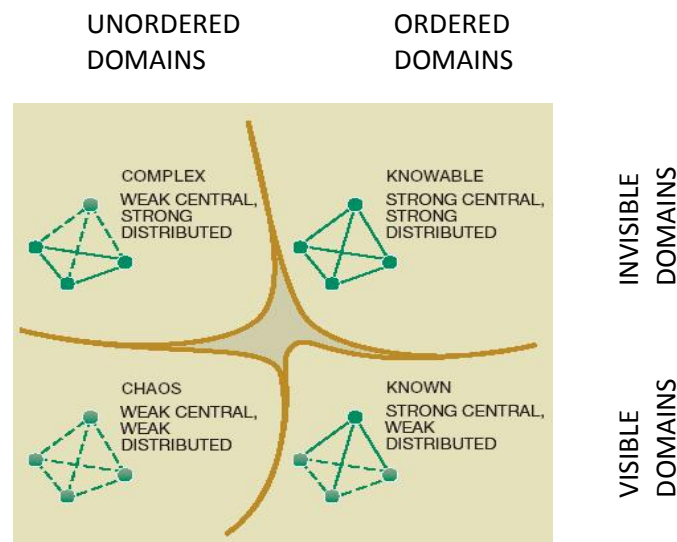


Figure 1: The Cynefin framework drawn from Kurtz and Snowden (2003).

As depicted in Figure 1, this framework provides a basis for understanding the variety of contexts, situations, problems, tools and solutions that exist in five conceptually different Domains, 2 of *order*, two of *unorder* and one of *disorder*. As described by Hasan et al (2010) the four outer Domains moving anticlockwise from the bottom right are:

- The Known or Simple Domain, in which the relationship between cause and effect is

publicly accepted and where there is top down authority. The approach suited to this context is to Sense - Categorize - Respond (SCR).

- The Knowable or Complicated Domain, in which the relationship between cause and effect requires analysis or some other form of investigation. Here there are strong vertical and horizontal connections between all actors. The approach here is to Sense - Analyse - Respond (SAR).
- The Complex Domain, in which the relationship between cause and effect can only be perceived in retrospect, not in advance. Here, organisational arrangements are network-centric with weak ties to centralised authority. The approach is to Probe - Sense - Respond (PSR) and then allow emergent practice.
- The Chaotic Domain, in which there is no relationship between cause and effect and weak ties between all actors. The approach is to Act - Sense - Respond (ASR) to discover novel practice.

In proposing Cynefin, Kutz and Snowden (2003) distinguish between the two large Domains of *order* and *unorder* and then talk about three ontological states, each with a variety of epistemological options: one state of *order* and two states of *unorder*, namely *complexity* and *chaos*. Order is divided into two smaller Domains namely the Known Domain (sometimes called Simple) and the Knowable or Complicated. In the two bottom Domains (Known/Simple and Chaos) *order* or *unorder* is clearly and publicly *visible* whereas in those on the top (Knowable/Complicated and Complex) the nature of a situation or problem is not publicly *visible* and needs to be discovered in different ways. Situations in the top right Domain are *complicated* but *knowable* so that problems here can be solved by rational 'scientific' analysis.

In contrast, situations in the top left Domain are complex and not completely understood so that the effort is directed towards problem resolution rather than solution using approaches consistent with Complexity Theory. Systems in the Complex Domain are inherently non-linear. Here *attractors and boundaries* replace *command and control* and *self direction* replaces *imposed rules and regulations* so that new patterns of practice can emerge. This is the Domain where the tenets of the Law of Requisite Variety and the Triple Bottom Line are particularly useful. Diversity of perspectives, knowledge and skills are invaluable and approach which do not address the mix of economic, social and environmental imperatives are doomed to failure.

Disorder, the central Domain, is the destructive place of not knowing which ontology you are in and where multiple perspectives compete as different actors interpret the situation on the basis of their preference for action. "Those most comfortable with stable order seek to create or enforce rules; experts seek to conduct research and accumulate data; politicians seek to increase the number and range of their contacts; and finally, the dictators, eager to take advantage of a chaotic situation, seek absolute control. The stronger the importance of the issue the more people seem to pull it towards the domain where they feel most empowered by their individual capabilities and perspectives" (Kurtz & Snowden 2003 p470). This can be seen when there is a breakdown of organisation or where communities are ill-prepared for unprecedented events and disasters, whether man-made or natural. A *disordered* situation is one that fosters or reflects neglect of civil responsibility as well as unethical or illegal activity. "The way out of disorder is to reframe the context so that constituent parts can be located in the other four domains where decisions and action can take place in contextually appropriate ways" (Dotson et al 2008 p43). "Entering into the domain of disorder from a single fixed viewpoint or a single Cynefin Domain may be a recipe for further chaos and eventual collapse of an organisational solution" (Fielden 2006).

Grounding Cynefin in Practice

The Cynefin framework can be used as a functional lens for sense-making of both the static and dynamic aspects of business processes. In static mode, a problem can be understood in terms of the ontology of a particular Domain so that suitable methods and tools can be applied. In dynamic mode, problems and situations move between Domains as they evolve and so need to be treated in different ways over time. The boundaries between the Domains are blurred and porous so that how a particular problem or situation is perceived at any point in time can be contentious. The Cynefin interpretation of the static and dynamic aspects of problems and situations are best illustrated by some examples.

Order: All modern organisations rely on information systems to routinely process transactions and provide management information. These systems are well *ordered* and, while they may not be entirely *simple*, their performance is predictably *known*. It is a relatively low-skilled job to carry out basic business functions following well-established procedures using these systems. In Cynefin terms, operations such as Accounts, Payroll, Ordering and Sales appear *visibly ordered* to most people in the everyday running of a business. The *complicated* components of the systems themselves are *not visible* to the average employee, supplier or customer of the firm. These are understood and created by experts in IT, database and programming. The specifications for the systems are also *complicated* and need the skills of professionals in systems analysis and design. The development of organisational information systems assumes that the requirements are *knowable* and that experts can go through the *complicated* process of creating a set of specification and engineering these ‘specs’ into a software package. To the lay person this is *non-visible order*.

Unorder: The Internet is one system that is *visibly unordered*. It is a chaotic network of networks with no central control and access is open to anyone anywhere at virtual no cost. In the words of Eric Schmidt, CEO Google, the Internet is “the first thing that humanity has built that humanity doesn't understand, the largest experiment in anarchy that we have ever had.” The Internet provides the infrastructure for the World Wide Web (WWW) which can be considered the greatest information system ever known. In its short existence, a great diversity of patterns of use of the WWW have emerged, with capability and sophistication that is only apparent once it happens. This is a great example of *complexity* theory in operation. As the dot-com boom and bust has shown, setting up business on the Internet is no guarantee of success but there have been some innovations that have succeeded spectacularly: Amazon, Facebook, Wikipedia, Skype, Twitter and so on. With Google Apps anyone can set up their own management information system and run a business from anywhere there is Internet access. There are low barriers to entry and every encouragement to try out an idea to see if it takes off. What is essential however is the ability to operate in the Domain of Complexity where there are few controls and little ability to predict outcomes.

Disorder: Sudden unanticipated crises such as the Hurricane Katrina, the BP Oil Spill or the events of 9/11 can throw organisations into chaos. In retrospect it is often obvious that these events happened in contexts that were *disordered*. In the case of the natural disaster in New Orleans it was clear that the city and the whole country had done little contingency planning for such an event and were unable to act swiftly as the situation demanded. In the case of man-made environmental catastrophes, investigations of incidents such as Bhopal, Chernobyl, and Exxon Valdez, invariably show poor organisational governance. A sign of *disorder* in the BP context are reports that the U.S. oil fields are increasingly ‘killing fields’

as deaths among workers rise as inexperienced crews work longer shifts¹. For the deliberate act of terrorism, the 9/11 perpetrators belonged to a fanatical group of people that distorted religion to justify acts that was abhorrent to the majority of humanity; a group whose activities were neither anticipated or prepared for by other stakeholders. All these situations were not benignly *unordered* but belligerently or negligently *disordered*. Fielden (2008) proposes the concept of ‘mindfulness’, a neutral state of awareness requiring maturity and wisdom, as a necessary precondition for understanding organisations in *disorder* that may without attention lead to disaster.

The dynamic Cynefin lens can make sense of change as situations move between the Domains. Introducing an attractor into a *chaotic* situation can move it from the Chaos Domain to the Complex Domain (eg the ubiquitous water-cooler can encourage previously disconnected employees to talk to each other). Imposing Standards on a *complex* disconnected industry can introduce *order* (e.g. standardising the national rail gauge meant a knowable inter-state train timetable). A catastrophe can change an *ordered* situation into chaos. Automation can move a task from *complicated* to *simple*.

An Appreciation of Unorder

As stated previously, while order is widely understood and valued, unorder is not always appreciated. By its very nature, recognising unorder and choosing tools appropriate to help resolving unordered problems, is itself usually an unordered activity that can best be undertaken by those who appreciated the value of unorder. The Cynefin framework leverages the often unordered human process of sense-making to align methods and tools to the demands of situations, and to solve business problems in holistic ways that are appropriate to situations in each Cynefin Domain. Just as a *complicated* ERP system, such as SAP or Oracle, would not be suitable for a *simple* corner store, Google Apps would never support a large *complicated* company. *Unorderd* social networking applications are often banned from *ordered* bureaucratic organisations although encouraged in more open organisations like Google whose espoused culture states “Our commitment to innovation depends on everyone being comfortable sharing ideas and opinions”². This way of organising relies on subjective judgement and what follows here are some subjective views on tool-task alignments.

The ability to conduct business transactions over the Internet via e-commerce has made a huge change to the relationship between a business and its customers. Customers now go online and interact directly with the organisation’s operational system. They can purchase goods, arrange a loan from a bank or book a holiday without contact with any employee of the business. However these are well-known *ordered* processes and people external to an organisation are not allowed access to anything too *complicated* or too sensitive. The usability laboratory where I work has shown how difficult it is to design a usable public interface when the task itself is not *simple*. One example of a poor attempt to simplify a complex process is the Australian Government online site for people wanting to register a new business; the choices offered are so confusing that most users give up

Many types of ICT applications that have been developed are deeply embedded with human factors and must be considered as essentially socio-technical. These include Expert Systems, Decision Support Systems, Business Intelligence Systems, Knowledge Management Systems and Intranets. There are limits to which these can be considered *ordered* but they are often used as such, which is not very sensible. In my university, for example, Sharepoint is used as

¹ http://www.msnbc.msn.com/id/26645108/ns/business-eye_on_the_economy/

² <http://www.google.com.au/intl/en/corporate/culture.html>

an Intranet but is set up in a very bureaucratic fashion to store documents, templates, procedure and guidelines as well as carry announcements and news. The Intranet loads automatically as a second Tab when we open the web browser on our office computers. However, most of us rarely look at it, relying on emails and word-of-mouth to know what we need to know, and no-one seems to use the ‘sharing’ or ‘collaboration’ functions.

Efforts to ensure sustainable through sensible organisation are only just beginning and can benefit from closer examination with the lens of the Cynefin framework. The contrast between *order* and *unorder* is reflected in the dichotomy between Green IT and Green IS. Boudreau et al (2008) distinguished ‘Green IS’ from the more widely used term ‘Green IT’ by saying that in Green IT, IT takes an *ordered* negative view of IT as an energy consumer and a major contributor to GHG emissions. Green IS, in contrast, tackles a much larger unordered problem in a positive manner. The most prominent work in this area is that of Watson et al (2010) who describe their work on energy informatics but they also suggest that we can incorporate our Green IS knowledge and skills in areas, such as Ubiquitous Computing, Human–Computer Interaction, and Decision Support Systems, to design systems that solve problems of sustainability. These issues involve change, risk, collective knowledge and social learning as well as allowing appropriation of suitable technologies and methods to support *unordered* business processes. They typify what are called ‘wicked problems’ (Rittel & Webber 1975) which defy obvious solutions or have conflicting objectives. Wicked problems are ill-defined, with shifting definitions and multiple elements whose conflicting objectives necessitate resolution through a complex, holistic perspective. Hasan and Kazlauskas (2009) recognise that one of the most pressing wicked problems facing humankind, is climate change which comes with a whole raft of interrelated environmental concerns: Water, food, land degradation, species extinction, population growth, pollution etc. The pervasiveness of ICT in all human activity make it sensible that they are considered not so much a part of the climate change problem but as having the capacity to be a necessary part of the solution (Ghose et al 2009).

In most organisations a state of *order*, or at least a perception of *order*, seems to dominate and only a real crisis will change this. One of my students has been investigating the significance of informal networks within bureaucratic organisations (in her case the Australian Defence Force). Her research is showing that it is only when there is a breakdown of order, or when complete disorder produces chaos, that people take advantage of their informal connections to “Act - Sense – Respond”, which is the way of working in the Complex Domain. In crisis zones people do what they can, with what is available and see what works. When most infrastructure was crippled, mobile phones were brought into action in disasters such as the Hurricane Katrina and the Haitian earthquake not just for communication and co-ordination but also to collect information to interactively map locations of need and supply (and more recently outbreaks of Cholera³) as well as to galvanise global support. Now Haitian telecoms and banks are racing to sign up residents for mobile banking plans through which payments are made electronically from mobile phone to mobile phone. The money is stored in an “electronic wallet”, the phone’s SIM card, instead of a drawer or under a mattress⁴. In these examples, people have appreciated the need for innovative solutions to complex problems that often emerge through chaos and disorder.

Most organisations are not facing an imminent chaotic disaster on the scale of the Haitian earthquake and carry on in their traditional *ordered* manner even when face with extremely complex situations. A striking example of the predominance of the ordered approach in

³ see for example http://new.paho.org/hq/images/Atlas_IHR/CholeraHispaniola/atlas.html

⁴ <http://www.globalpost.com/dispatch/americas/101207/haiti-mobile-banking#>

business is evident in the Vision 2050 report released at the 2010 World CEO Forum in New Delhi, India. Twenty-nine companies, led by Alcoa, PricewaterhouseCoopers, Storebrand and Syngenta, identified the roles that business must play over the next few decades to enable society to move toward being sustainable and came up with the agenda shown in Figure 2. This is as ordered as you can get with nine disconnect themes all following the same rigid phases, based on the world as we know it today. There is no flexibility to respond to the unexpected, which is not sensible, and even negligent, given our experience of unprecedented change over the last forty years. There is obviously no appreciation of the complexity of the challenge and a retreat to a comfortable corporate paradigm of imposing order.

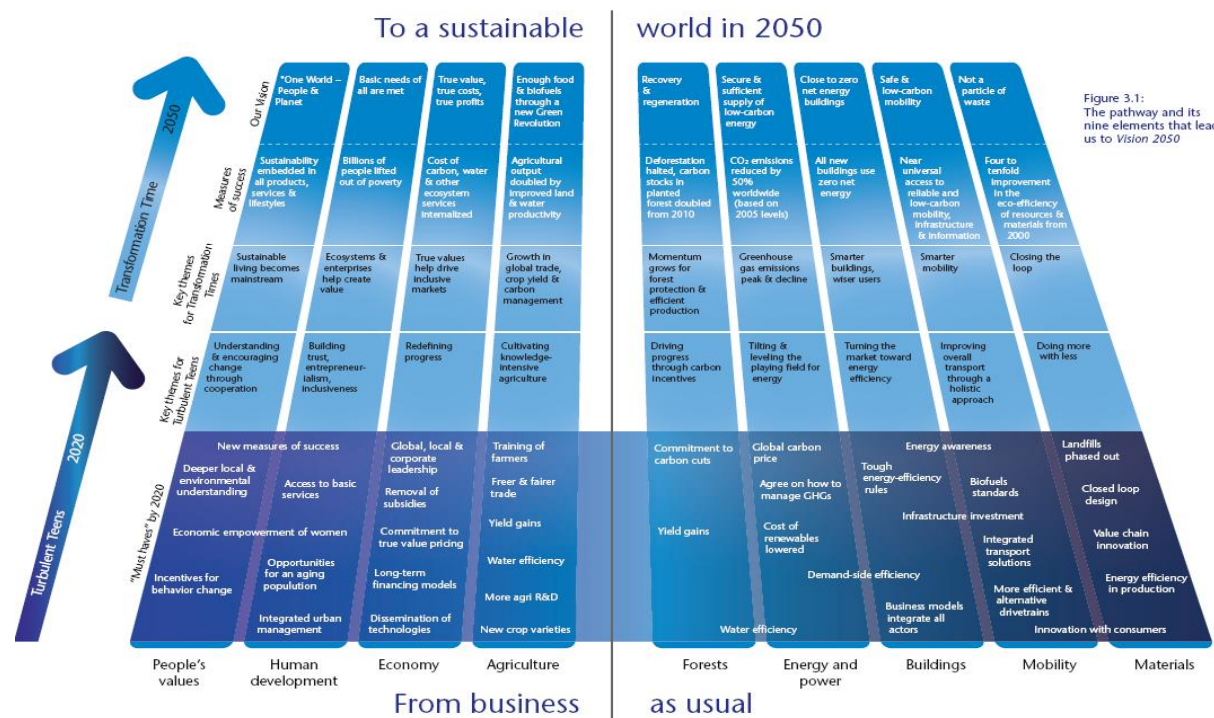


Figure 3.1: The pathway and its nine elements that lead us to Vision 2050

Figure 2. The Vision 2050 pathway to a sustainable future (Vision 2050)

Recognising and Appreciating Unordered in BPM

In my opinion, most BPM research and practice assumes order in business processes, or at least seeks to impose order on them. It may be difficult for the field of BPM to recognise that unordered is a valid state and appreciate that it is wrong to always want to simplify and impose order. BPM researchers and practitioners tend to have knowledge and skills that are technical, mathematical and suited to rational analysis. This is appropriate for order but not necessarily for unordered where we find most problems concerned with sustainability and, consequently, their most appropriate means of resolution. Tools, methods and contexts that support enterprise sustainability should include unordered socio-technical systems and even ecosystems that suit the Complex Domain having intricate components, complex interconnections and adapted to rapid change (Hasan 2005, Hasan & Kazlauskas 2009). Thus the knowledge and skills required by those working on complex problems should be broader than the technical and mathematical skills suited to ordered BPM and include systems and social elements.

Researchers and practitioners tend to avoid unordered processes as they are visibly chaotic. However their underlying complexity can be of great interest to researchers and can be the source of innovation in practice where they can to be probed and manipulated to allow new

patterns of sustainable processes to emerge. Aspects of Complexity Theory, developed in biology, are relevant to this Domain in particular the concepts of attractors and boundaries to encourage patterns of emergent behaviour leading to innovative responses to challenges of sustainability. Three examples of ICT based attractors and boundaries that have encouraged innovative behaviour follow.

Innovative product design: Some enlightened companies are producing products that their customers and clients really want by involving them as volunteers in the business via the WWW, while at the same time lowering costs and being environmentally responsible. One example of this is the online Lego user community that proposes new designs for the Lego product (Bauwens 2008). Another is CNN⁵ which has instigated a program, i-report, where viewers supply news stories online as text, images and video from every corner of the globe. This replaces the need for CNN to station reporters everywhere or to move them around to trouble spots. In an evolutionary process the stories are monitored and the reputation of these volunteer reporters grows as their submissions prove to be accurate and news-worthy.

A military community of practice: 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 members of previous generations and equipped to fight a war against numbered, mechanized regiments in open-manoeuvre warfare. Here they were patrolling foreign city streets where the next building could house an innocent family or a sniper. Instead of looking up to the outmoded Army for instructions, they were advising each other how to fight the war in this more complex setting generating a new more relevant field manual.

Funding innovation: There are many stories told of the glory days in Silicon Valley where money was thrown at bright young ICT whizzes in the hope that they would come up with the next great invention. This same approach can work for innovation within traditional companies where employees are offered some funds, resources and a portion of the company's time if they want to explore and experiment with new ideas.

In each of these three cases there are obvious boundaries on what could be done but enough attractors, include new ICT systems, to encourage valuable outcomes. While there are no guarantees of what the outcomes will be, these are typical of projects that use an appropriate approach for the Complex Domain. They have low economic, social and environmental costs, but good chances of valuable outcomes.

Resolving complex unordered problems

From my knowledge and experience of situations such as those described above, I recommend the steps listed in Figure 3, for resolving problems in the Complex Domain. It is advisable that these nine steps are followed in a collaborative and iterative manner with attention to performing well along the triple bottom line (economic, social and environmental) and to generating the level of diversity warranted by the context. There are also other concepts relevant to the Complex Domain.

⁵ <http://www.cnn.com/iReport/>

1. Acknowledge the problems or situations as complex
2. Envisage possible desirable outcomes
3. Identify possible paths for resolution towards those outcomes
4. Identify suitable attractors and boundaries and apply
5. Probe and evaluate response in order to recognise pattern formation
6. Encourage / reward those patterns that make progress along that path
7. Look for unexpected innovations
8. Continuously reevaluate the situation to see if it is still complex or, if order has emerged change the approach
9. While still complex – re-evaluate the identify paths, attractors etc and change if necessary

Figure 3 Steps for resolving problems in the Complex Domain

One of these is the wisdom of looking for, and fostering, ‘hidden attractors’. Many complex business processes work because of hidden attractors that are often not recognised and may only become visible when they are removed. Here is an example of this. When I started work at my present university over 20 years ago we had morning and afternoon tea time with ‘tea ladies’ to set up and clean up afterwards. Between duties, the tea ladies from all over campus would get together and ‘exchange gossip’ (i.e. transfer knowledge). It was at morning and afternoon tea that much useful communication took place and through the tea ladies that we all found out what was happening in other parts of the university. These are classical hidden attractors for a happy workplace. Then, in an effort to show a tangible gain in productivity, the “tea ladies’ were retired and the tea-times no longer supported. In less than a year management was complaining that people were no longer communicating and that barriers had built up between Schools and Departments. Since then many quite expensive programs have been put in place to re-connect members of different units and there have been several instances of restructuring in an effort to revive the old collegial atmosphere. It might be noted that an effective way to locate hidden attractors in organisations is through story-telling, a techniques often used by Cynefin consultants.

Advocates of Cynefin suggest that when working in the complex domain begin with a few small-scale trial initiatives. If the outcomes are desirable they are then supported and extended. If the outcomes are undesirable then the initiative is discouraged and something different can be tried. It is also desirable to allow ‘safe-fail’ where all initiatives are set up to fail without serious damage to the organisation or blame on the individuals. This is the opposite of ‘fail-safe’ where initiatives are designed not to fail. A basic principle of complex systems is that small differences in the starting conditions (and every problem context is different) can result in very large differences in the outcomes. While developments may be understandable in retrospect they were not predictable at the time of their instigation.

The big changes and problems

The advice of starting small echoes the environmental mantra of “acting locally but thinking globally”. So the ‘small focus’ also implies the ‘big picture’ where we see the problems of sustainability locally complex but also embedded in an unpredictable changing global context that includes climate change. The big picture sees some fascinating revolutions underway to whole industries as the following examples show.

Digital Products: ICT and the Internet have completely revolutionised those industries dealing with products that can be digitised: information, knowledge, education, news, books,

movies and music. With no need for physical products there is a lower carbon footprint but many firms have had to change their entire business model to remain viable.

Retail: In Australia there is a crisis in the retail industry as with the high value of the Australian dollar and no Goods and Services Tax on items from overseas more and more people are buying foreign goods online. A new phenomenon here is for customers to try products such as clothing in the store and then go online to buy them. Companies in the retail industry are reassessing what is the 'shopping experience' that brings customers to their stores that will thus provide them with business.

Financial Services: Just as many businesses are recovering from the Global Financial Crisis other issues are emerging. The growing use of online services is driving government agencies, banks, insurance companies, and investment brokers to cut costs by closing down local branches. As a result they are losing personal touch with customers and clients. At the same time there is a growing use of Customer Resource Systems (CRM) to store and make available all sorts of data on customer habits, preferences and lifestyles.

Other industries are in the midst of change from more contentious issues: in agriculture the benefits of genetic engineering are being opposed by public reaction; the coal industry is beset by uncertainties about what governments may do to cap or tax GHG emissions; health is strained by the rising burden of an aging population with no obvious means of matching funding; the military rarely engages in big battle between international forces but rather in civil conflicts and peace keeping duties to rebuild and train; and industries that deal with the public, such as airlines and sports promoters, must take care of increasing security risks without being over intrusive to innocent members of the public.

The holistic view

There are many aspects of these big concerns that are knowable and can be dealt with by complicated but basically ordered processes. However, there are also contradictions that inherently cannot be resolved completely and hence remain complex. When business are perceived through the Cynefin lens, sustainability thus becomes a matter of sorting out whether problems or situations are order, unordered or disordered and proceeding along the following lines.

- Order: When cause and effect are known and consistent over place and time, use the familiar "design, develop and then implement the solution" form of engineering. Such approaches work well in ordered situations.
- Disorder: Where there is disharmony, inequality, a lack of ethics, poor governance, corruption, greed or neglect then there is disorder, a blatant need for change and the potential for disaster. As well as preparing for possible disaster recovery, these problems and their source need to be addressed moving them to one of the other domains (eg through regulation to order or culture change possibly to unordered). In respect of the latter it is interesting to note that one of the causes of the lack of detection of the threat that led to the 9/11 disaster was stated as a "lack of imagination". Imagination, and other attributes of emotional intelligence, are rarely listed as a job requirement in intelligence agencies but maybe should be.
- Unorder: Where the situation has characteristics of complexity follow the steps of Figure 3, being careful not to remove any helpful hidden attractors and apply the principle of safe-fail where possible to learn from mistakes and to change a culture of concealing mistakes are through fear of retribution.

As discussed above, there is a lack of research on problems in the Complex Domain and lack of suitable social-technical skills among BPM professionals to recognise and address complex processes. More attention to this area may provide much of the understanding and innovation required for sustainability.

Speculating on the future

Most of the Green IS literature focuses on ways ICT can help mitigate climate change by reducing GHG emissions. This is typified by the work on energy informatics (Watson et al 2010). I believe we should also focus on how ICT can help us adapt to the impact of climate change. As I write this chapter, an area the size of France and Germany combined is flooded in North Queensland. Australia has plenty of experience in dealing with such large scale disasters: floods, fires, cyclones, droughts etc, and so has developed a diverse set of resources that mobilise in response. However over the past few years we have had too many of these and they have been more severe than ever. There is widespread agreement that the world will experience many more of these extreme events as the climate changes and we need to adapt.

As the flood events unfold, there is much discussion in the media on how the devastation will affect the local and national economy, what businesses have been affected, how communities will recover and what new facilities can be put in place to flood proof infrastructure.

Governments here are also beginning to plan for the persistent and recurring consequences of climate change more generally. These consequences include the rising costs and scarcity of resources such as energy, water, food; conflicts over these resources; local overpopulation; movement of whole populations; and reshaping of cities and neighbourhoods. Note that 85% of the population of Australia lives in coastal regions, many of which will be affected by even small rises in sea-levels.

In all the political and public media discussion, the role of ICT is rarely mentioned which is surprising considering that the cost and rollout of a new National Broadband Network has regularly been in the Australian political spotlight. ICT that can support *unordered* ways of working involve Web 2.0 social media, virtual collaborative tools, and streaming video for health, education etc. There is resistance to these in many traditional organisations (Hasan & Pfaff 2007) but they are taking hold.

But what of the future? The Vision 2050 plan shown in Figure 2 looks forward 40 years from now. Forty years ago did anyone envisage how the Internet would globalise business and everything else? It is thus foolish try to predict the technological advances of the next ten to forty years. However, a useful technique to use with unordered problems is to imagine possible future scenarios. The following are trends where we could imagine future ICT-based systems driving new innovation as follows:

Easing the strain on the big cities: intelligent systems to stagger business hours in the CBD, mobile guides to public transport, flexible tele-commuting arrangements

Improved lifestyles for regional, rural and remote area: services for remote business customers, support for employees to sea-change or tree-change away from working in the city, broadband services for education health, government and financial services,

Reducing the need to travel for business: going virtual with socio-technical approaches that are useful and usable, affordable multisite teleconferencing and collaboration tools

Devolved decision making for a more democratic workplace: investigating different ways of organising that put more resources into doing the business at the coalface and less resources into managing the organisation from the top; in other words inverting the organisational

pyramid to put the customer at the pointy end, and giving self directed sales teams the authority to make strategic decisions. All this would need support from very different ICT systems to the ones we have now with more open policies on access and end-user design.

Optimising in the large not the small: for interconnected systems, independent optimising of parts of the system may lead to non-optimal performance overall.

Qualitative evaluation of performance on the triple bottom line: the use of heuristics for key performance indicators, the use of stories to represent what is happening countering the tendency of simple statistics to cover up and only provide 'green-washing'.

Avoiding loss of corporate memory when the current generation of workers retires: setting up communities of practice which maintains contact and interaction after retirement.

Leveraging the skills of Gen Y and the digital natives: as Web 2.0, 3.0 4.0 come online. There is evidence of changing values with each new generation that tend to be more cooperative, more socially and environmentally aware and more tolerant of diversity⁶.

Conclusion

The need for businesses to focus their attention on sustainability is undeniable but making sense of the diversity of problems is an enormous challenge even before they seek solutions.. Some environmentally-related threats to sustainability are well-known: energy costs will rise and non-renewable resources will become scarce. We are receiving a wake-up call from the increasing frequency and severity of large-scale environmental disasters and extreme weather: unprecedented floods, mudslides, fires, earthquakes followed by tsunamis, blizzards, hurricanes and cyclones. Businesses need to do what they can to prevent these, mitigating climate change by reducing GHS emissions and good governance against industrial catastrophe. However the greater sustainability effort may be in preparing for the unexpected and adapting to continually changing circumstances. ICT and the Internet are already playing a significant role in spreading this message and getting information to the masses.

Despite the enormity of the problem, the Cynefin framework provides a way of making sense of its many facets and then guiding choices on appropriate ways to proceed. Identifying situations as ordered, unordered or disordered provides a starting point. For those situations which are ordered we already have methods that work and skills to follow these through. Disordered contexts can be toxic where situations need to be converted to order or unordered. Situations which are unordered seem visibly chaotic but most of these have an underlying complexity where the steps in Figure 3 can be followed towards desired outcomes. This may be the least comfortable domain for BPM but one with the greatest opportunity for sustainable innovation.

We are currently living in a volatile time and the future will be more so. While the challenges of each organisation is unique to its own circumstances, the Cynefin framework can be used as a sense-making tool in particular to understand complexity and developing appropriate skills and socio-technological systems to work on the complex problems of sustainability. Two extant concepts that support Cynefin in explicating complex issues of organisational sustainability are the Law of Requisite Variety, which advises organisations to leverage diversity to match that of their environment and Triple Bottom Line which assumes that an organisation is more likely to be sustainable if it honours its responsibilities to its environment and to all stakeholders (shareholders, customers, employees and the community) in providing products or services. The message of this chapter is that an order roadmap such

⁶ <http://millennialmarketing.com/2009/07/values-shift-gen-y-sees-things-differently/#>

as that shown in Figure 2 is virtually meaningless when we look forty years into the future. There are clear signposts that organisations need to develop much more flexible and adaptable ways of working if they are to be sustainable in the 21st Century. This implies embracing unordered business processes and investing in ICT systems that support these.

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