Multi-ontology sense making
a new simplicity in decision making

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Imagine organising a birthday party for a group of young children. Would you agree a set of learning objectives with their parents in advance of the party? Would those objectives be aligned with the mission statement for education in the society to which you belong? Would you create a project plan for the party with clear milestones associated with empirical measures of achievement? Would you start the party with a motivational video so that the children did not waste time in play not aligned with the learning objectives? Would you use PowerPoint to demonstrate to the children that their pocket money is linked to achievement of the empirical measures at each milestone? Would you conduct an after action review at the end of the party, update your best practice database and revise the standard operating procedures for party management?

No, instead like most parents you would create barriers to prevent certain types of behaviour, you would use attractors (party games, a football, a videotape) to encourage the formation of beneficial largely self organising identities; you would disrupt negative patterns early, to prevent the party becoming chaotic, or necessitating the draconian imposition of authority. At the end of the party you would know whether it had been a success, but you could not define (in other than the most general terms) what that success would look like in advance. *David Snowden*

The purpose of this article is to introduce a new simplicity into acts of decision making and intervention design in organisations. That may seem ironic given the title, with its use of the terms "ontology" and "sense-making" which may be unfamiliar to readers; but new ideas often need new or at least unfamiliar language and I make no apology for that. Some readers may wish to skip the remainder of this introduction which may only be relevant to academics wishing to situate my language. New language aside, the basic principles that underlie this paper are very easy to understand and are illustrated by the example of the children's party above. Multi-ontology sense making is about understanding when to use both methods of management outlined in the story, both the structured and ordered approach based on planned outcomes and the un-ordered, emergent approach focused on starting conditions expressed as barriers, attractors and identities.

Ontology[1] is derived from the Greek word for being and it is the branch of metaphysics which concerns itself with the nature of things. In this article I am using it to identify the different types of system, and will later discuss two contrasting types of ontology (order and unorder) each of which requires a different approach to both diagnosis and intervention. In practice we need to consider three physical and five human ontologies. The three physical ontologies are order, complexity and chaos; in human systems order divides into visible and hidden forms and we add a fifth state of disorder. These are more fully described elsewhere (Kurtz & Snowden 2003). For this article I will combine complex and chaotic into a single category of unorder and ignore disorder.

Sense-making is most commonly associated with the Weick (1995) and Dervin (1998) and is starting to gain more attention in management circles. I am closer to Dervin than Weick, and in the context of this paper I am talking about sense making as the way that

humans choose between multiple possible explanations of sensory and other input as they seek to conform the phenomenological with the real in order to act in such a way as to determine or respond to the world around them. Multi-ontology sense making is thus a means to achieve a requisite level of diversity in both the ways we interpret the world and the way we act in it. Requisite diversity means ensuring the acceptance of a sufficient level of divergence to enable the sensing of weak signals (terrorist threat or market opportunity) and avoidance of the all too common pattern entrainment of past success, while maintaining a sufficient focus to enable decisive and appropriate action. Above all it is about ensuring cognitive effectiveness in information processing and this gaining cognitive edge, or advantage.

The ideas and concepts may be novel and even threatening to a generation of managers, civil servants and academics who have been trained in what I will later define as single-ontology sense making. The dominant ideology of management inherits from Taylor (1911) a view of the organisation based on the necessity and the probity of order. In the Taylorist world things are deemed to be known or knowable through proper investigation and relationships between cause and effect once discovered repeat. It is the world of the mechanical metaphors used by most management theorists who came after Taylor; it is the Newtonian universe of predictable relationships between cause and effect which can be calculated; the world of the five year plan and the explicit performance target; of hypothesis and empirical proof through observation and explanation of events in retrospect. This paper challenges that particular *weltanschauung* not by denial, but through bounding and limiting its applicability.

The fad cycle in management theory and practice

Single ontology sense making itself in a by now all too familiar pattern and can be summarized and to a degree satirized as follows:

- An Academic group studies a range of organisations to identify causal linkages between things those organisations do and results that they achieve or fail to achieve, from which they derive a hypothesis that forms a definition of best practice. A popular management book then follows and a new "fad" is born.
- Consultants and IT providers[2] produce industrial strength recipes based on the new idea, ideally involving a consultancy process, followed by a technology implementation and some form of organisational change or cultural alignment with the programme to orientate employees to the new goals
- Managers go through a process based on the recipe to determine a desired end state defined in terms of economic performance, behavior characteristics etc. They then determine the current state and identity a series of process steps to achieve that goal and roll out the programme promising substantial improvements to their stake holders many of whom in the "employee" category are already suffering from substantial initiative fatigue. Some years after the fad has run its course in industry and the limitations the consultants find a lucrative secondary market in applying "industrial best practice" to government clients.

It is not my intention to argue against management fads per se; indeed the different perspectives and novelty that they introduce can be valuable even though in the main they are based on an out of date understanding of science in the context of management and organisations. Equally, I am not denying that substantial benefits have been achieved over the years through these new methods and ideas, although the benefits are often over claimed or not sustained beyond their initial novelty-value impact.

That said, it is my contention that the vast majority of these methods have been simplistic in their conception and execution; in particular when they claim universality of application.

I am using simplistic here in a negative sense in contrast to simple and I will argue later that simplicity can lead to complex solutions, while being simplistic leads to over-complication. To illustrate this, one of the dominant fads of the last fifty years, namely Business Process Engineering (Hammer & Champy 1993) emerged, as do many methods from manufacturing, shifting from a horizontal focus on product in contrast with the previous organisation by functional silos. As such it worked well, but then it was over extended beyond its valid ontological boundary (I will define this term later) to more human less mechanical aspects of the service sector at which point it started to fail. A similar point can be made in respect of the Learning Organisation (Senge 1990), Emotional Intelligence, Knowledge Management and many others. Multi-ontology sense making argues that different approaches are legitimate, but within boundaries and that methods and tools that work in one ontology, do not work in another. It is thus behoven on management to know which ontological domain they are operating in, and what transitions between domains they wish to achieve.

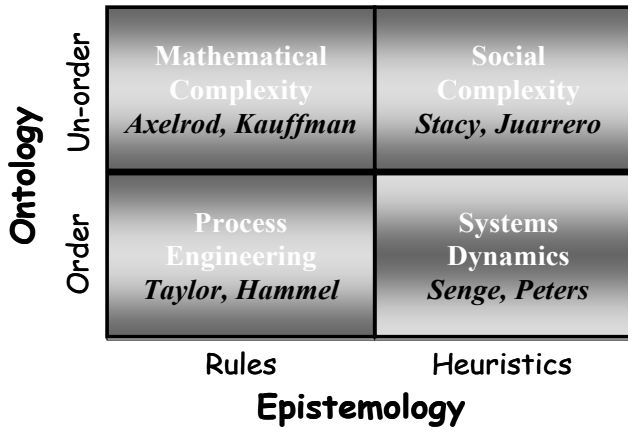
So, what are the boundaries that exist that legitimize or invalidate methods? To demonstrate this I intend to use a categorization model "The landscape of management" which is designed to position the various types of management theory that have evolved over the last century and discuss some of the implications that arise from that model.

This paper will not cover sense making using "The Cynefin Model" that provides a framework for managers to determine the boundaries between ontologies, and the dynamics of cross boundary movement between ontologies. Readers interested in a detailed discussion should look to two other papers: Kurtz & Snowden 2003 and Snowden 2004 both of which can be obtained from www.cynefin.net.

The landscape of management

The two by two matrix set out here contrasts the nature of systems (ontology) with the nature of the way we know things (epistemology) and accordingly the way we act; I contend that knowledge and action are intimately intertwined (Snowden 2002).

The matrix was originally produced from a EU Study on knowledge management and was used to demonstrate that the strategic advantage for Europe (and I would contend for Africa and Asia not in imitating the USA, but in utilizing its multi - culturalism as a competitive advantage through of social complexity in which it currently has an lead. I have more fully described the matrix some its implications elsewhere (Snowden 2003), and (Stanbridge & Snowden 2004) and the full report can be obtained from www.cynefin.net is recommended to readers.



The vertical dimension of the matrix contrasts types of system, namely order and un-order. the earlier story of the childrens' party the first namely that of objectives, planning and best effect an illustration of the type of approach that typically adopted in an ordered system. This is legitimate where there are clearly identified (or identifiable) relationships between cause and effect, which once discovered will enable us to control the future; then the system is ordered. It can be structured on the basis of a desired outcome with structured stages between where I am "now" and where I want to be "then".

This is contrasted with un-order in which the relationships between cause and effect do not repeat, except by accident and in which the number of agents interacting with other agents is too great to permit predictable outcome-based models, although we can (as is the case with the party) control starting conditions and monitor for emergence. "Un" is used here in the sense that Bram Stoker uses it of Dracula: the un-dead are neither dead not alive, they are something different that we do not fully understand or comprehend.

At its simplest, the difference between management in order and un-order can be summarized as follows. Ordered systems are those in which a desired output can be determined in advance and achieved through the application of planning based on a foundation of good data capture and analysis. In un-ordered systems no output can be determined in advance, in other than in the most general terms but we can manage the starting conditions and may achieve unexpected and more desirable goals that we could have imagined in advance, or (and this is commonly the case especially in the case of teenage parties) we can just be more successful in avoiding failure.

While the vertical dimension represents two distinct states, the horizontal dimension is more of a continuum between the low ambiguity of rules that can easily be made explicit and the more ambiguous use of heuristics or rules of thumb which provide guiding principles but have high levels of ambiguity. I sometimes illustrate this difference by comparing a complex US government manual on procurement (anyone who has contracting under US Government rules can take you to highly complicated web sites which prescribe all possible circumstances on the basis that anything which is not explicitly permitted is not allowed) with a mission or value statement for an organisation which states broad principles that set expectations, can be comprehending quickly and are easily memorable; as a result of which they can be applied without reference to the rules.

Having established the dimensions, we can use the model to look at the current situation in respect of management theory by taking each of the quadrants in turn, and in doing so look at the limits on their applicability.

Process Engineering
Ordered ontology, rule based epistemology

In effect the last century of management theory and practice, from Taylor's Scientific management (1911) to its logical extreme Business Process reengineering most commonly attributed to Hammer and Champy (1993) is dominated by an ordered ontology. A strong mechanical metaphor characterizes these approaches. The focus is on efficiency, stripping away all superfluous functions in order to ensure repeatability and consistency. The most recent manifestation is Six-Sigma[3] originating in GE which continues the focus on efficiency with a strongly quantitative approach to measurement although with some cult like overtones in its imagery: black belts etc.

It is a common characteristic of engineering approaches that they start in manufacturing processes where they gain their initial success and then extend to other less structured aspects of an organization, at which point, problems start to emerge. One reason for this is the important difference between a focus on efficiency and one on effectiveness. The engineering process takes place in a specific context and once achieved, shifts in that context require the engineering design process to be repeated to some degree before efficiency can be achieved again. Radical shifts in context may make the entire approach redundant or lead to catastrophic failure. In the context of a manufacturing plant or a stable industrial sector this is not a problem, or if it is a problem it is shared by all of our competitors. We have to make major investments in process to achieve efficiency and, once made, that investment is always a sunk cost. Manufacturing plant, payment systems in a bank, and the like, are all closed systems that can be structured and standardized

without any major issue. We can in effect define best practice. However when we apply the same techniques to systems with higher levels of ambiguity, for example customer interactions, sales processes, and the like, we encounter more difficulties. Some of these arise from the fact that significant aspects of what we know cannot be measured or made explicit: we always know more than we can say, we will always say more than we can write down. Others arise from the impossibility of anticipating all possible situations as well as shifting context. In these cases we need a different focus, one of effectiveness in which we leave in place a degree of inefficiency to ensure that the system has adaptive capacity and can therefore rapidly evolve to meet the new circumstances. Examples would include apprentice schemes of knowledge transfer, maintaining mavericks or misfits, allowing people to take training in subjects with no apparent relevance to their current jobs and providing more delegated authority.

Boisot (1998) makes the valid point that organisations who invest heavily in knowledge creation tend to assume that the same knowledge will require similar costs for their competitors and thus focus a massive effort on protection through patents etc. He calls these N-Learning organisations in contrast with S-Learning cultures who see value arising from the exploitation of knowledge, not its possession and thus tend to share and collaborate even with competitors. The open source movement is a good illustration of the latter. Boisot goes on to demonstrate through several examples the way in which N-Learning cultures fail to adapt to changing circumstances; these include IBM's failure to see the change to micro computers until it was almost too late, and the failure to understand the operating systems market to the point where they lost it to Microsoft. There are many other examples, particularly in other large companies, which have adopted engineering processes and built large bureaucracies and enforcement procedures.

There is nothing wrong with an engineering approach; there are many things that need high degrees of order and control. However taken to excess, and it has nearly always been so taken, it sacrifices human effectiveness, innovation and curiosity on the altar of mechanical efficiency.

Systems Thinking (Dynamics)
Ordered ontology, heuristic based epistemology

Towards the end of the last century we saw some rebellion against the mechanic metaphors of scientific management and its successors. Tom Peters in various speeches and books, Senge (1990) with Learning Organisation, Nonaka with various co-authors in books and articles covering Knowledge Management represent the more popular examples. Systems thinking challenges the apparent simplicity of process based approaches and their associated mechanical metaphor arguing for both non-linear relationships between cause and effect and the greater ambiguity of human systems. We see the birth here of approaches based on articulating mission statements, establishing value systems and determining ideal behavior all of which would then be mandated for employees. Senge argues that employees should sacrifice their individual objects and goals to gain from the assumption of a common identity in the organisation to which they belong; Nonaka recognizes the social nature of human knowledge transfer and the need to separate tacit knowledge sharing from the process of making tacit knowledge explicit; Peters emphasizes motivation and leadership. The ambiguity of human systems is recognized, but the basic concept of central control or planning remains at the heart. Leaders set objectives, they (to use Senge's metaphor) are the designers of the ship. Competences and behaviors it is argued can be taught and learnt and alignment of the individual with the collective is thus possible.

One of the easiest ways to identify a systems thinking approach is to look for the process models – those with lots of boxes, arrows and feedback loops are generally characteristic of systems thinking. By accepting that the world is more complicated than implied by

process reengineering and the introduction of feed back loops, concepts such as double loop learning and discourse analysis, systems thinking humanized the heirs of Taylor to a degree. However the basic assumptions of order pertain. Systems are configured based on goals; humans are seen as assets or capabilities that can be aligned with those goals. Reductionism still stands; think of the balanced score card (Kaplan and Norton, 1996), another popular manifestation of systems thinking philosophy in which the range of activities of an organisation are reduced to a set of measurable items in which the whole is assumed to be the sum of the parts because the measures are interconnected. The strength of systems thinking is its recognition that human systems are messy, they frequently need focus and alignment; its weakness is that it assumes that the design of that focus and alignment is a top down goal-based process.

Like Process Engineering, Systems Thinking is strongly linked to computer based automation and modeling. The speed of computers allows the complication of systems thinking models to be calculated on a consistent basis with associated reporting and control mechanisms. For complicated aspects of an organisation it is very powerful, allowing models to be constructed to enable an understanding of the inter-relationships between people, process and technology (a three fold focus mantra that typifies thinking in this domain). When the number of people, the complication and context changes associated with process and the capabilities of technology exceed a threshold level the system shifts from being complicated to being complex, from order to un-order in which an output cannot be defined in advance and in which the sheer number of relationships means that order emerges from the interaction of the various agents over time, and the form of that order is unique to each emergence. At this point we shift to the unordered quadrants.

Mathematical Complexity[4]
Unordered ontology, rule based epistemology

"A new awareness of the ancient counterpart to order began over a century ago with Poincaré and several others, and has surged in recent decades (e.g., Nicolis and Prigogine 1989, Lorenz 1993, Holland 1998, Kaufmann 2000). In fact there is a fascinating kind of order in which no director or designer is in control but which emerges through the interaction of many entities. Emergent order has been found in many natural phenomena: bird flocking behaviour can be simulated on a computer through three simple rules (e.g., Reynolds 1987); termites produce elegant nests through the operation of simple behaviours triggered by chemical traces (e.g., Camazine et al. 2001); each snowflake is a unique pattern arising from the interactions of water particles during freezing (e.g., Ball 1999). The patterns that form are not controlled by a directing intelligence; they are self-organizing. The new science of complexity spawned by these findings is interdisciplinary, touching fields from mathematics to evolution to economics to meteorology to telecommunications. In the domain of emergent order, a goal "to predict (and thereby control) the behavior of systems not yet studied (but similar to those that have been studied) under conditions not yet extant and in time periods not yet experienced" (Arrow et al 2000) is difficult if not impossible to achieve – but other goals are achievable.

Awareness of emergent order has as yet had comparatively little influence on mainstream theory and practice in management and strategy (for a good introduction see Axelrod and Cohen 1999) however there are a growing number of examples. Computer based simulations based on agent models have been used to handle complex issues such as traffic management and package routing for airlines. A growing use is in economical modeling and clustering. The procedure here is to look at a population of human agents and identify the rules on which they make decisions, then produce a computer model in which individual agents make decisions based on those rules and order emerges as a result.

Note a key difference here with ordered systems, unorder is bottom up; although mathematical complexity shares the concept of rules with business process re-engineering along with the associated heavy reliance on computing power, the rules apply to agents from which behavior emerges, it is not possible to create rules top down for that behavior, but the rules apply at a lower level of agent behavior.

We also see one of the most interesting aspects of a complex system, namely its simplicity; a few rules give rise to complex forms of order. This leads to a contrast of simple-complex with simplistic-complicated which while not universally true is a useful way of looking at the problem.

Of course not all systems are unordered, and applying an unordered approach based on agent simulation would be dangerous if we used it for something like payment systems in a web based trading system or for the regulatory processes of the pharmaceutical industry. Accordingly we should resist the Universalist claims of some complexity practitioners as much as we resist those of engineering and systems thinkers. There is however another limitation to mathematical complexity namely the fact that other than in a limited set of circumstances human beings are not the same entities as ants, birds or crystals. I am sometimes amazed that this point has to be made, but have come to the conclusion that for many economists and sociologists they would like humans to be ants as then their mathematical models would work. The differences between human systems and ants, is similar to the differences between human systems and the mechanical metaphors of process which gave rise to Systems Thinking; which leads us logically to our final quadrant.

Social Complexity
Unordered ontology, heuristic based epistemology

Social complexity shares with mathematical complexity the concept of unorder and emergence, but also shares with systems thinking the belief that human systems are different; these differences are summarized in the next section. Social complexity is linked in some cases to postmodernism (Cilliers 1998) and has some strong advocates in the field such as Stacy (2001) and Juarrero (1999). It is the main focus of the Cynefin Centre which I founded (www.cynefin.net) and offers interesting possibilities for the government and industry alike.

The relevance of social complexity is illustrated by the metaphor of the children's party with which this article stated and which aptly summarizes the differences between an ordered and unordered approach. The first approach to managing a children's party is based on the assumption of order, the second is based on unorder. The argument is not that one or other approach is absolutely right or wrong, but that both are right (and wrong) in context.

This awareness of context is not common in Management science and consultancy practice which is dominated by approaches based on an assumption that the systems being researched and managed are essentially ordered in nature. They are thus susceptible to methods based on best practice and the creation of structured top down approaches. In ordered systems we can create repeatability and scalability with consistency. Failure is a failure of design or implementation not a result of the nature of system itself.

The importance of learning how to manage in unordered environments is easily understood by looking at the dilemma facing governments around the world. On the one hand they face increasing requirements for the provision of public services, but on the other they have static or declining levels of resource. Managing unorder through the manipulation of boundaries, attractors and identity offers a potential path to the resolution of that dilemma; managing unorder on the basis of methods and tools appropriate for ordered systems requires deployment of major resources and the likelihood of making things

worse. The same dilemma & opportunity exists for not-for-profit and commercial organisations alike.

Unique aspects of human systems

Different schools of thought identify different distinguishing features of human systems. The following summary has been developed from various sources over the years in the context of creating explainable and comprehendible reasons for management audiences engaged in the early stages of applying thinking from social complexity[5].

Humans make decisions based on patterns

This builds on naturalistic decision theory in particular the experimental and observational work of Gary Klein (1994) now validated by neuro-science, that the basis of human decision is a first fit pattern matching with past experience or extrapolated possible experience. Humans see the world both visually and conceptually as a series of spot observations and they fill in the gaps from previous experience, either personal or narrative in nature. Interviewed they will rationalize the decision in whatever is acceptable to the society to which they belong: "a tree spirit spoke to me" and "I made a rational decision having considered all the available facts" have the same relationship to reality.

Accordingly in other than a constrained set of circumstances there are no rules to model.

Humans create and maintain multiple identities

An individual can be distinguished by their roles, clans or context. We both create and maintain multiple often parallel identities shifting between and amongst them as needed without so much as a second thought. As a male individual I can be father, brother, son or husband, I can switch between work based identities or home based ones. My employees if distanced from me may never associate my person with the role I occupy. I am a member of many clans, from sporting clubs, cohort groups, participants in a senior executive programme: there are many examples. Context is of particular interest here, working as a crew in a bush fire by identity is very strongly associated with the role and common threat and I can sustain it for a period of time while I am "on watch"; however such a contextual identity and the behaviors associated with it cannot be transferred outside of the context.

Accordingly in other than a constrained set of circumstances there are no clear agents to be modeled.

Humans ascribe intentionality and cause where none necessarily exist

There is a natural tendency to ascribe intentionality to behavior in others, whilst assuming that the same others will appreciate that some action on our part was accidental. Equally, if a particular accidental or serendipitous set of actions on our part leads to beneficial results we have a natural tendency to ascribe them to intentional behavior and come to believe that because there were good results, those results arose from meritorious action on our part. In doing so we are seeking to identify causality for current events. This is a natural tendency in a community entrained in its pattern of thinking by the enlightenment. Deacon (1997) has established that the concept of co-evolution of the brain and language removes the need for a "universal grammar" as an explanation of language and a similar application of Ockham's razor can remove much of the supposed causality in both government and industry. One of the key insights of social complexity is that some things just "are" by virtue of multiple interactions over time. The concept of a single explanation, ascription of blame or for that matter credit are not necessary.

Humans have learnt how to structure their social interactions to create order

For the purpose of this article we will avoid the potentially troublesome concept of free will and instead focus on the ability of humans through social structures and less tangible things such as myth, ritual and taboo to create stability and predictability in their systems. Depending on where you live it is correct to drive on either the left or right hand side of the road, we have advanced from the adaptive nature of bird flocking behavior (fly to the centre of the flock, avoid collision, match speed) as a means of managing traffic to create a predictable form of order that not only provided stability in our day to day lives, but also allows planning for road design etc. This is linked to the human capacity to store knowledge in the external environment, or "scaffolding" to use Clarke's (1997) term. Humans have thus learnt how to move between order and unorder.

Contextual Complexity

Couple the above differences with the phenomenological aspects of human perceptions of reality and we see that there are substantial and major differences between human and non-human unorder. This led the Cynefin Centre to coin the term "contextual complexity" in contrast with "participative complexity" from Stacy (2001) and colleagues. Contextual complexity argues that humans have the ability to operate in all quadrants of the model and the ability to move between them as a result of both accidental and deliberate action.

Multi-ontology sense making then recognises the need to adopt different diagnostic techniques, different intervention devices and different forms of measurement depending on the ontological state. This is contrasted with any single ontology form of sense making whether based on order, complexity or chaos. Understanding this concept of ontological switches also helps prevent the degeneration into "un-manageability" and fatalism which can occur when people start to understand complexity based thinking.

The order and unorder distinction has many applications and these are summarized in the table below.

ORDER	UNORDER
Focus on rational individuals making choices based on personal self interest	Focus on identities making decisions based on patters arising from personal experience and collective knowledge expressed in narrative form
Manage to achieve goals based on ideal models and central planning	Manage starting conditions and monitor for the emergence of patterns which will be sustained or disrupted
Simplistic-complicated	Simple – complex
Efficiency (focus on core capability, outsource the rest)	Effectiveness (requisite diversity, allow inefficiency for adaptability)
Exploitation	Exploration

Structural stability	Resilience and adaptability
Reductionist measures: ROI, balanced score card etc.	Indivisible, emergent measures
Measure outcomes based on explicit goal based criteria	Measure the stability of barriers, the attractiveness of attractors and the stability of identities
Dichotomy and the resolution of dilemmas as an either or choice	Dialectic and the resolution of paradox to see the world in a different way
Analysis and Expert interpretation	Stimulated emergence so that the patterns of possibility become more visible.
Economic example – credit scoring	Economic example – micro lending

The above summarizes material which has already been explained, or implied in the text above. Some examples are more enigmatic, such as those on measurement and are covered in referenced articles. The final economic example deserves more explanation and also allows as simple case to form the conclusion of this article and exemplar of an unordered intervention. The case is drawn from Axelrod and Cohen's (1999) introductory text on mathematical complexity.

This is the Grameen Bank (Yunas 1999) which was created in Bangladesh to provide small loans to poor people. The name Grameen comes from the Bangla word for village. This is a market which the conventional banking system finds unattractive. Most commercial and private loans are based on credit scoring, an ordered concept in which the characteristics of good and bad debtors are identified and used as predictors and therefore controls for future lending. This increases the cost of lending as the various processes have to be administered, and small loans thus become uneconomic. In the Grameen Bank everyone who took out a loan was required to be a part of a self regulating borrowers' group in which each member of the group had to take responsibility for the debts of the others. This simple rule which costs little to administer produced a 97 percentage repayment rate comparable with best achievements of the large banks; there are now over two million clients of the Grameen bank and the approach has proved both scalable and portable.

I find the Grameen Bank an inspiring case, and an illustration of the great benefits that complex or unordered thinking can bring. Just as in the case of the children's party, managing the starting conditions, not an idealized end state, can produce lower cost more effective solutions. Complex thinking is not a nice-to-have in modern management, it is a fundamental necessity and in the history of management science is another "Taylor" bringing a new science to bear for the first time. It is a new and exciting way of thinking about the world that, properly understood, does not mean that we abandon any of the ways we currently manage, but instead understand and apply the boundaries to their application. With that change we enter a new simplicity in management decision making.

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Notes

[1] Ontology is commonly misused in the IT profession as an elevated version of taxonomy and is in fact closer to onomastics than it is to ontology

[2] Consultants and IT Vendors are becoming increasingly interdependent and often identical. One can trace the large growth of management consultancy to the advent of Business Process Reengineering as a management philosophy and the development of enterprise wide software solutions such as SAP. Indeed the financial model of the large consultancy firms is increasingly dependent on large scale technology implementation with associated programmes for design, cultural change etc.

[3] Six Sigma shares some aspects with Systems Thinking and is not solely confined to Business Process.

[4] The quoted paragraphs that start this section are extracted from the previously cited Kurtz and Snowden article

[5] This section is largely extracted from the Stanbridge and Snowden article previously referenced and published in Emergence – probably the international journal of social complexity http://emergence.org