
Postmodernism revisited? Complexity science and the study of organisations

Jacco Van Uden, Kurt A Richardson, Paul Cilliers. **Tamara : Journal of Critical Postmodern Organization Science**. Las Cruces: 2001. Vol. 1, Iss. 3; pg. 53, 15 pgs

Abstract (Article Summary)

Van Uden et al assert that the world is best described as being a complex system, and, through the use of the 'complexity' discourse, students of organizations--organizations being regarded as complex sub-systems of the whole--can benefit from the various complexity science research programs. They argue that complexity theory in this respect is reminiscent of postmodern organization theory.

Full Text (9320 words)

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ABSTRACT

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In this paper we simply assert that the world is best described as being a complex system, and, through the use of the 'complexity' discourse students of organisations - organisations being regarded as complex sub-systems of the whole -- can benefit from the various complexity science research programs. The paper supports a complexity-based view that essentially justifies the need for paradigmatic pluralism and boundary exploration. We argue that complexity theory in this respect is reminiscent of postmodern organisation theory, contrary to the New Reductionism of the majority of complexity writings. We will discuss some important observations in complexity theory and explore, in a rather playful fashion, how the insights could affect our understanding of organisations.

INTRODUCTION

An empty promise?

It is becoming rather monotonous to continually read organisational-related articles that tell us how the concept of (and the requirements for) the modern organisation is (are) changing, how it is more complex than ever, and how a paradigm shift is necessary in order to facilitate our continued analysis, and management, of such entities. We are told that we must distribute decision-making, encourage individual autonomy, and strive to innovate in the rapidly changing environment that characterises the apparent New World Order. These concepts coincide with a new, or at least emerging, description of organisations. This 'paradigm' appears, from particular presentations at least, to wholly reject the long held prevailing paradigm of the mechanistic, efficiency-driven, hierarchical command and control organisation. (We would question the 'wholyness' of this position.)

Complexity science has emerged from the milieu of possible candidates as a prime contender for the top spot in the next era of management science. The number of management trade books on the subject has exploded with provocative titles such as *Leading at the Edge of Chaos* (Conner, 1998), *Rearing the Corporate Brain* (Zohar, 1997), or *Adaptive Enterprise* (Haeckel, 1999) to name but a few. The majority of these popularist writings, particularly the management science books, seem to claim that the 'old' thinking needs to be (wholly) replaced with 'new' thinking, and that a new, all-embracing perspective, sometimes referred to as 'complexity thinking', is available that will solve all our apparent woes. Of course, much of this is the hype that accompanies any 'New Science', and we should know by now that the inevitable disappointment is also not far away.

In management science, authors might fairly be accused of preying on the needs of the modern-day manager who is becoming increasingly anxious as the acknowledgement that the neatly packaged MBA style approach to organisational management just doesn't seem to yield the results that such an approach might have once brought: it's the New Economy, stupid! We suspect that similar accusations might also fairly be directed toward proposal writers who play on the insecurities of policy makers whose grip on a concrete understanding of world order is apparently weakening.

Applying complexity science

How are we, as students of organisation, to apply this 'complexity thing' then? In a special issue of *Emergence*, Maguire and McKelvey (1999) reflect on the reviews of over thirty books that deal with complexity science applied to management, and make a case for 'serious research'. Together with some reviewers, Maguire and McKelvey fiercely oppose to the sloppy work of certain authors: "Not unexpectedly, the complexity gurus are most upset with how complexity science terms are loosely, if not metaphorically, defined and tossed in managerial discourse - one goes as far as to suggest that the book offers many insights for managers but one should simply black out all references to complexity science... other reviewers worry about 'loose definition' and applications, 'oversimplification', 'incorrect use of concepts', 'superficial' treatments, lack of research, and missing the computational modeling underlay of complexity science" (1999: 55). Maguire and McKelvey observe this development with great regret because they are convinced that "the record is clear over the past several decades - management ideas that do not become legitimised by resting on a foundation of quality research are quickly replaced by the next fad coming down the pike" (1999: 19). And so they formulate the conditions for a serious research programme that will show that "there is more than metaphor to chaos theory and complexity science applications, and that CEOs using New Science produce more competitively advantaged firms than CEOs who do not" (1999: 57). Fuller and Moran, too, argue that when "there is no grounding of these analogies in [the world of small firms], there is no evidence that complexity has validity in describing or explaining empirical observation" (2000: 50).

Metaphorical application consists of the imposing of ideas, features, concepts, theories etc. that are derived from one phenomenon onto a different phenomenon. For instance, you think of an organisation as a prison and you try to make sense of the organisation by applying words such as inmates, guards, punishment, isolation, 'doing time' and so on. The 'more than metaphor' school asserts that such a way of going about is essentially wrong because obviously organisations are organisations and not prisons. How does this compare to the application of complexity science, which deals with complex systems, to organisations? According to Maguire and McKelvey, the application of complexity theory to organisation is justifiable because, essentially, organisations and complex systems are not different phenomena. Maguire and McKelvey contend that underneath the earthly surface, organisation is essentially a complex system. From this it follows naturally that the application of complexity theory to organisations is not metaphorical in nature but rather that complexity theory literally describes what organisations are all about. Having assured that the authors feel confident to argue that complexity theory demands that its

quantitative nature is addressed: "complexity science and computational modeling go hand in hand" (1999: 56-7). Elsewhere McKelvey's argues that if "we are to have an effective complexity science applied to firms, we should first see a systematic agenda linking theory development with mathematical or computational model development" (McKelvey, 1999: 24).

Bold statements about the imposing, alleged quantitative nature of 'the complexity research programme' convince authors such as Chia (1998) that 'this complexity theory thing' is the latest in modernist tools to take over the field of organisation studies. He argues that the 'qualitative difference between the social world and the world of inert material' makes complexity theory unsuitable for application in the field of organisation studies full stop. According to Chia, because of its roots, complexity theory is unable to address "issues of subjectivity, meaning, the limitations of language, and the essentially interpenetrative and transformative character of human experience" (Chia, 1998: 342). Maguire and McKelvey as well as Chia have an a priori understanding of what complexity can do for/to our understanding of organisation based on the presumption that the quantitative disposition of complexity science is inevitable. But both hope and fear of a straightforward application of the complexity discourse seem unwarranted. If anything, the reviews in the special issue of Emergence indicate that students of organisation studies often apply ideas and concepts of the complexity science without giving too much thought about what these ideas and concepts meant in their 'natural habitat'. As such, the way students of organisation studies embrace the complexity sciences does not seem to differ greatly from how 'alien theories' are usually received. Despite its proclaimed revolutionary potential--the conviction that it will cause an unprecedented paradigm shift-complexity theory turns out to get 'moderated' in the process of applying it to our understanding of organisation.

As was the case when they drew from sources such as anthropology, ecology, the medical sciences, the military sciences, the field of engineering and so on, students of organisation studies take bits and pieces from the complexity sciences and customize them to make them suitable for their field. Organisational researchers rarely deploy the concept of strategy with reference to what it means or used to mean in the military sciences. No professor of strategy checks the justness of his application of the concept of strategy with army officials because in the field of organisation, too, 'strategy' has become a useful concept in its own right. And there is little reason to suspect that complexity awaits a different, less 'opportunistic' treatment. To students of organisation studies, the value of new insights from alien theories does not derive from the extent to which the imposing claims of complexity theory have been applied prudently. And neither should it. When offered a new theory, students of organisation studies are meant to ask: what's in it for organisation? Will this new theory confirm what we, students of organisation studies, already knew? Or do the lessons of complexity force us to reconsider our usage of familiar organisational concepts? Does it affect the issue of leadership-- if conventional theories of organisation stress the importance of leadership and the complexity sciences offer the concept of the edge of chaos, does it make sense to join these concepts and explore requirements of 'leading at the edge' (Regine and Lewin, 2000)? Similarly, does complexity science enhance our understanding of production processes? Or more specifically, does this self-organisation make managers superfluous? Do initial conditions matter to group dynamics? Or would it affect our just-in-time logistics policy? What can the concept of strange attractor do for me if I wish to get employee morale up again? Should the notion of non-linearity have consequences for our theories of decision-making? Such playful questions contrast sharply with Maguire and McKelvey's guidelines for 'serious research'. This 'loose' approach to application could also temper Chia's upfront dismissal--perhaps not of complexity theory per se but of the possible outcomes of the translation of complexity theory to the field of organisational studies. Even if Chia is right in his observation that complexity theory amounts to "a deliberate programme of simplification in which the vague complexes of sense-experience are systematically compressed and converted into a conventionally recognizable and accepted form of discourse" and that therefore "complexity science is thus ultimately reductionistic in its intent"--which is a very questionable conclusion--then, still, applied to organisation the effects may prove very different from that (Chia, 1998: 344--original italics). This is even more because Chia's reading into the complexity sciences seems

very selective. There are many cues from complexity that actually seem to be supportive to Chia's ambition to address themes of 'subjectivity, meaning, the limitations of language, and the essentially interpenetrative and transformative character of human experience'. Although for all sorts of reasons it is a rather cheeky one, we nevertheless dare to assert it: complexity science provides an unexpected Modernist argument for the lines of thought that have been offered by authors often referred to as postmodernists.

Aims of this paper

The aim of this paper is to present a view of complexity science that pays particular attention to the epistemological ramifications of assuming complexity. We will by no means attempt a rigorous study into the validation of our underlying 'complexity' assumption - these are taken for granted. What we intend to do, is show how complexity science raises familiar issues in (the problems of) the understanding of organisations from an unfamiliar angle. We will do so by familiarising the reader with the concept of the 'complex system', and explore some of the features of complex systems that lured us into believing that organisation studies may benefit from the research performed by complexity scientists. We wish to find out if organisations can somehow be thought of as complex systems and could therefore be 'susceptible' to the insights derived from the various complexity research programs.

One way of determining the value of complexity theory to our understanding of organisations is to argue that a theory of organisations informed by complexity theory hardens (i.e. becomes more 'valid'), as some authors seem to suggest (see, for example, Maguire and McKelvey, 1999). Our route, as can probably be gleaned from our explication thus far, is less inspired by such 'physics envy'. Although complexity science has its roots in hard sciences, and therefore runs the risk of being allocated by 'rigorous' organisational scientists who seek to find an ultimate description of the organisation within the realms of pure mathematics, we propose a more playful 'postmodernesque' application of complexity science. We contend that complexity theory-or at least a particular 'version' of it-provides us with a framework that enables us to make sense of organisations by directing our attention to processes already under investigation by postmodernism. We believe that the potential benefits from some sort of marriage between programs of complexity science and postmodernism are worth exploring. The following section does exactly that. It is a very tentative tour in which we explore the usefulness of complexity-thinking to our understanding of organisation.

WHAT IS A COMPLEX SYSTEM?

A simple definition

Let's assume for the moment that organisations can be conceptualised as complex systems. But what are complex systems? Joslyn et al. (2000) offers the following description of a complex system:

"... any system consisting of a large number of interacting components (agents, processes, etc.) whose aggregate activity is non-- linear (not derivable from the summations of the activity of individual components), and typically exhibits hierarchical self-- organisation under selective pressures."

So, rather simplistically, a complex system can be described as a system that is comprised of a large number of entities that display a high level of interactivity. (The obvious shortcomings that arise from such a simplistic definition are discussed in Backlund, 2000 and Richardson, 2001). The nature of this interactivity is non-linear and contains manifest feedback loops. It is interesting to note that as a result of this high connectivity it can often be very difficult to associate effect with

cause—we are now confronted with incredibly intricate interacting networks of cause and effect rather than the relatively easily identifiable chains of cause and effect apparent in complicated, or linear, systems. These rich and pervasive dependencies place fundamental limitations on our abilities to develop and validate appropriate models of complex systems. Joslyn's basic description of complex systems, as well as more comprehensive 'lists' of complex systems' characteristics (e.g. Cilliers, 1998) seem to justify the assertion that organisations as we know them match the profile of complex systems and therefore benefit from the various complex systems research programs. The following sections will discuss the nature and implications of the characteristic observations associated with complex systems behaviour in turn and explore briefly its potential message to the students of organisation studies.

Observations in complex systems

There are a number of basic observations that have been made through the examination of such systems, primarily, through the use of computer simulation and the mathematics of non-linearity. The proceeding sections will discuss the nature and implication of these observations in turn. For a more complete list, refer to Cilliers, 1998.

(a) The incompressibility of complex systems (Cilliers, 1998: 4) - Complex systems are incompressible, i.e. it is impossible to have a total account of a complex system that is less complex than the system itself without losing some of its aspects. Incompressibility is probably the single most important aspect of complex systems when considering the development of any analytical methodology, or epistemology, for making sense of such systems.

(b) System memory/history (Cilliers, 1998: 4) -A complex system has memory/history captured at both the micro- (e.g. personal experiences, personal opinions, worldview) and macroscopic (e.g. culture, ritual, value system) levels. Therefore system history plays an important role in defining the state of the system as well as affecting system evolution.

(c) Chaos and self-organisation (Richardson et al., 2000) - The system evolution is potentially incredibly sensitive to small disturbances (a phenomena popularly referred to as deterministic chaos) as well as being potentially incredibly insensitive to large disturbances (as a result of self-organisation or, alternatively, anti-chaos). All possibilities in between also exist. Complex systems are often quite robust.

The following sections will explore these issues in greater detail.

The incompressibility of complex systems

Complex systems are incompressible, i.e. it is impossible to have a complete account of a complex system that is less complex than the system itself. This is probably the single most important aspect of complex systems when considering any methodology for developing understanding of such systems. Complexity science basically tells us that everything is connected to everything else. Therefore if we were to take the low risk option we, as scientists, would be forced to take the first proposition of Wittgenstein's Tractatus, namely 'The world is all that is the case,' (Wittgenstein, 1921) quite literally—a tad impractical! This unitary holism is generally forgotten all too readily because of its apparent triviality. Complexity science attempts to bring back to the foreground explicitly what is usually pushed to the background implicitly. It tells us there is a genuine danger in focusing on the (functioning of the) parts of a system at the expense of attention to the interactions between these parts. What appears to exist autonomously or as such is actually the result of a process of taking into consideration and, inevitably, leaving out of consideration. Complexity science tells us that, as everything is interconnected, we should be reluctant to blindly accept what appear to be the evident and obvious boundaries that separate

one 'thing' from the other. In fact, it is asserted that the boundaries analysts infer around a system are more a feature of our need for a bounded description rather than a feature of the system itself. Hard enduring boundaries do not exist in nature; all perceived boundaries are transient given a sufficiently broad time frame. Even the resilient proton, the exemplar of stability, is expected to decay, or reorganise, after a sufficiently long period. Recently a British physicist Humphrey Maris has controversially claimed that even the 'indivisible' electron can be broken into two under certain conditions (Chown, 2000). This is not to say that assuming such hard and persistent boundaries exist is an inappropriate approximation in all cases, as long as we explicitly acknowledge the 'approximationness' and provisionality of such assumptions—the antithesis of the modernist view.

The paradox of reducing the irreducible

Given that no hard enduring boundaries can exist according to complexity (except those boundaries describing the fundamental irreducible components of the universal system), the use of the term 'system' is itself misleading as it suggests the existence of completely autonomous entities, or entities that are easily differentiated from their complement. Even the move to use the term 'open systems' trivialises the recognition of systems as such (though explicitly acknowledging the interactivity between system and environment). Maybe we should consider complexity science as a 'science of partial complex systems'. This usage implies that when considering any problem we are in fact investigating a part of a complex system. As such, all the hypotheses and concerns raised by a 'science of partial complex systems' would be appropriate for all analyses, rather than just special cases. This summarises one of the key 'problems' of complexity thinking: it makes sense to draw lines and delineate a particular (part of the) complex system, but by doing so we disconnect it from the 'habitat' in which the (partial) complex system makes sense. Richardson (2001 a), in response to this emergent ontology, argues for a quasi-critical pluralist philosophy that explicitly acknowledges the emergent and temporary status of boundaries from a complex systems perspective.

In the field of organisation studies, the concern with blindly accepting boundaries that are expressed here is reminiscent of the arguments of authors who are commonly referred to as postmodern organisation theorists. Their argument goes something as follows. Although singling out organisation as something *an sich* is an act most of us would consider justified, this act of isolating is not without danger. The establishing and maintaining of a concept such as organisation is realised by subtle and less subtle acts of inclusion/exclusion and prioritisation. Mainstream organisation theory, postmodern organisation theorists argue, limits its attention exclusively to the effects that follow from these series of inscriptions of 'organisationness'; it does not question the boundaries that prevent the rather well-defined concept of organisation from indeterminacy. Mainstream organisation theory leaves out consideration of what got excluded in the process(es) of establishing the limits of reach for the concept of organisation.

Postmodern or social-constructivist students of organisation studies offer a different approach. Their focus is not so much on organisations as it is on the processes of organising. They think of organisations as the volatile, unstable, temporary results of ongoing processes and interactions. Organisations as we know them are but particular punctuations among all that these processes could be. Organisations reflect as much what they are as they mirror the restrictions on what they could have been. The creation, upholding and acting on the concept of organisation, is an ongoing selection process; an act of inclusion/exclusion in which we make decisions on what to take into consideration in trying to understand this phenomenon so distinctive that we consider it sound studying it as if it were something as such. But, postmodern organisation theorists argue, when organisation is rendered real, it is crippled at the same time. Like chimpanzees taken from their natural habitat, drugged and brought to streets of Benidorm for drunken tourists to acknowledge their presence, organisation studies brings organisation to the surface but at the same time sucks the life blood from it by doing so. "Science begins by placing the perceptually

dynamic into a field of stasis. *Ceteris paribus* clauses, the experiment and the laboratory are all ways of stabilising the real world's perceptual flow.... The creation of stasis, the better to hold the scientific victim steady so that it might be anatomically examined, is a long one. We must look, perhaps, at the range of conceptualisations within organisation theory as ways of enforcing anatomising stasis upon the dynamics of organizational life. They are notions of and for stasis through which the mobile, the restless are forced to offer themselves up unto the gaze of the observers (Burrell, 1996: 645). It's the joy of directing attention followed by the immediate regret for having done so. "[...] we must realise that what every concept does is to exclude as well as to include, to ignore as well as to concentrate upon, to consign to obscurity as well as bring into the limelight" (Burrell, 1996: 646).

The 'dangers' of including/excluding are discussed quite extensively in postmodernism and, to a lesser extent, in complexity science (though the justification for such concerns in complexity thinking is quite different from those in postmodernism). Borders that signify where one thing ends and another starts, both schools hold, are somehow imposed rather than real in nature. In complexity science, all boundaries are emergent and temporary which not only problematises boundary recognition but also the temporal validity of boundary allocations. In a strict sense, complexity science does not even acknowledge the notion of 'parts' or 'objects' such as an organisation (Richardson, 2001b).

But the overlap in concerns addressed doesn't stop here.

History matters

Closely related to the concern with boundary allocation is the importance of history, again acknowledged by both complexity science and postmodernism. Complexity science argues that complex systems are characterized by a system memory. A complex system has memory captured at both the micro- (ie. component or element) and macroscopic (ie. system) levels. A complex system's past is co-responsible for its present behaviour (Cilliers, 1998: 4). A complex system makes little sense if the processes responsible for its behaviour in the course of time are not taken into consideration. When trying to understand the current 'state' of a complex system, one cannot but acknowledge the importance of its previous whereabouts. One could argue that, like science studies, complexity scientists try to understand the centrality of their research objects by showing sensitivity to its particular coming into existence. By finding out, for example, "for what periphery this content plays the role of the centre, of what veins and arteries it is the pumping heart, of what net it is the knot, of what pathways it is the intersection, of what commerce it is the clearing house." (Latour, 1999: 108) Organisations are the hearts, knots, intersections, clearing houses of specific veins and arteries, nets, pathways and commerces, so to speak. Organisations resulted, and keep resulting, from the coming together of particular demands and supplies, particular makings of livings, particular skills, particular technological advances, particular interests, particular venture capitalists seeking particular investments in particular geographical regions and so on. Essentially, the real, specific stuff organisations are made of, matters. The route to a postmodern appreciation of history in the understanding of organisations is somewhat different. Postmodern researchers understand organisations as the products of decisions made. By travelling 'upstream' (Chia, 1996) the decision tree that ultimately gave rise to the organisation as we know it, we learn about how these choices in the past affected the possible future 'shapes' of the organisation. After each decision some futures became more likely whereas other possible future states of the organisation were muffled if not killed. The organisation as we know it, in other words, makes little sense if we do not appreciate its history. Thus, history matters. What is interesting, however, is that complexity science nor postmodernism accepts that an organisation can be known if only we know its ingredients.

According to Juan-ero, at times, autonomous parts start interacting to such an extent that a complex macrostructure emerges. Consisting of nothing but seemingly ordinary parts, the

emerging complex system nevertheless has access to a repertoire of behavioural alternatives, unknown to the previously isolated parts. She concludes, therefore, that the "emergent level is thus qualitatively different from the earlier one" (Juarrero, 1999: 142-3). The emerging complex system seems to take over control at the expense of manoeuvrability of what were once seemingly autonomous parts. Despite their different roots complex systems share characteristics that makes them comparable as a kind. The emerging complex system seems to enter a realm where its 'complex systemness' is perhaps more significant to the researcher who wishes to understand it, than are its specific roots. We expect a South American high-tech car plant manager who works with men only to benefit from the written insights of an Asian CEO of a European cosmetics firm. The specifics, the particularities, seem to become less relevant in the light of the dawning 'being organisation'. For one reason or the other, organisations somehow seem to be understood in their 'organisationness', rather than with reference to their roots. The relevance of historical uniqueness seems to wear off in the course time. Why?

Chaos and self-organisation

The evolution of a complex system, like an organisation for example, is potentially incredibly sensitive to small disturbances (a phenomena popularly referred to as deterministic chaos) as well as being potentially incredibly insensitive to large disturbances (as a result of self-organisation or, alternatively, anti-chaos). Many scholars when contemplating complex systems latch on to the more popular phenomena of chaos and 'strange attractors' to such an extent as to suggest that complexity science is effectively synonymous with Chaos Theory, or simply an extension of Chaos Theory. Deterministic chaos, which is characterised by 'sensitivity to initial conditions', does occur in an infinity of constitutionally simple systems that contain non-linear relationships. If the world were indeed chaotic, as some would suggest, then there would be no hope for the (organisational) analyst, and no point in performing analysis whatsoever. And anyway, would you risk flying in a chaotic plane? It is quite obvious that the world is not chaotic, not completely anyhow. This is not to say that at times a complex system may behave deterministically chaotically, but this type of chaos should be seen as merely a possible behavioural mode that a complex system might adopt. It should certainly not be regarded as a behaviour characteristic of all such systems.

The world is not compositionally simple; however, it is compositionally complex, i.e., as we have already said, it can be considered to be a large number of non-linearly interacting entities. In such systems, self-organisation, i.e., the spontaneous formation of well-organised structures, patterns, or behaviours from random initial conditions, is also an important phenomenon. Self-organisation is impressively demonstrated in cellular automata experiments (see Wolfram, 1994, for further details). In such experiments, as there are a large number of elements, one might expect there to be a very large state space. However, when initiated with random conditions, they then tend to converge to small areas of this space (attractor basins): they self-organise.

What is important for the reader to realise is that the starting conditions for each of these evolutionary experiments are random. From these random beginnings an ordered evolutionary self-organised pattern is observed. In fact, whatever starting conditions are used, and assuming that the rules of interaction remain fixed, a qualitatively similar pattern will always emerge. In such experiments, we find that initial conditions play no part whatsoever in determining the qualitative nature of the evolutionary pattern. The initial conditions are forgotten; the system is insensitive to initial conditions. Furthermore, if these automata systems were perturbed at some point during their evolution, i.e., some of the element states were changed forcibly from the 'outside', the perturbation would quickly dissipate, the systems self-organising into their preferred structure. History, or institutionalism (captured in current practices), and self-organisation help explain how when attempts are made to re-organise a firm, they often fail, and the firm's employees quickly slip back into their familiar way of doing things.

To illustrate the complicated dynamics of a complex system we will consider a notional phase portrait (Allen, 1999) of such a system. A phase portrait is simply a visualisation tool that enables us to view which behavioural mode a system might self-organise into given a range of initial conditions. For an example refer to Exhibit 1. The exhibit shows that for different sets of initial conditions, different behavioural modes are adopted. These modes can be well-described by a variety of qualitatively different attractors. Each area of 'phase space', (known as attractor basins) that can be defined by a unique attractor is bounded by what is known as a 'separatrix'.

These boundaries, or separatrices, are commonly found to be very complicated structures, known as fractals. Fractals are structures that display self-similarity at infinite scales. We will not consider the mathematical details here of such structures, but note that separatrices are not necessarily clear and distinct meaning that determining the response of a complex system to an external event is often a highly non-trivial exercise. The complex structure means that the attractors that describe qualitatively different operational modes, rather than being separated by hard divisions, overlap. The result of this is that as the evolution of the system in question edges toward these boundaries the probability that the system might 'leap' into an adjoining attractor basin, adopting the behavioural mode that is described by the attractor therein, increases. The term 'bifurcation' is reserved to describe this leap from one attractor basin to another, i.e., a qualitative change in behaviour. Because of the 'fractality' of these boundaries, sometimes only a tiny perturbation (provided by 'noise' within the system for example) is sufficient to push the system into another basin. Of course, if the system is operating sufficiently far away from one of these boundaries then a small perturbation will not trigger such a change. Again, the systems qualitative behaviour is both sensitive and insensitive to small perturbations. In the words of Peter Allen (Allen, 1999) of Cranfield University, this is a way of appreciating how luck and circumstance (as perturbing forces) appear to play an important role in our lives.

ORGANISATIONAL DISCOURSE AS AN ATTRACTOR BASIN

How can we think of the issues addressed above as somehow being relevant to students of organisation studies? We propose the following line of thought. Organisations, most of us would believe, are comparable. Despite the fact that each and every organisation is essentially unique (different people, different products, different place, different time) there is something which keeps us from saying that they cannot be compared. Organisations somehow display similar behaviour. They look alike, they have similar job vacancies, they use the same accountancy software, they pay similar wages, they send managers to the same training courses, they handle customers complaints in the same way and so on. Whereas in theory, there are many ways organisations could emerge from 'independent parts', and we are confronted with so little apparent variation. It is as if organisations are being drawn or attracted to some ideal model of organisation. In complexity science, as was shown above, research into attractor basins has helped account for 'the spontaneous formation of well organised structures, patterns, or behaviours from random initial conditions'. If we think of an attractor basin, not as an external magnet that pulls the complex system towards itself, but as being somehow discursive in nature, a rather interesting explanation for the lack of variety in organisational forms emerges. Consider the following, quite common, situation in which university friends keep in contact while they work for different companies. At some time, they all realise that their jobs have become quite boring and that they express their wish to found their own company. As these friends decide to start their own business, organisational discourse, which has been guiding their thinking and acting in the background, becomes more apparent. The organisational discourse that constitutes their being leads them to ask question such as: What will be our product? By when do we need our business cards? What customers can we bring with us from our current employer? Where do we get our seed money from? Who will be our customers and how will they be able to find us? What kind of office will we need? What type of cars will we be driving? The friends, so to speak, carry 'organisation as they already know if already themselves. But it is not just the human resources of the organisation to be that have organisationness under their skins. The computer software that they will be using the cars that they will be driving the building they will be renting the

mobile telephones they will be using, carry organisationness within themselves, ready to imprint it into the slowly emerging organisation. The seemingly independent elements out of the organisation is to emerge, in other words, are already organisation-laden. This makes it difficult for the organisation-to-be not to become organisation. The friends, when trying to pick company cars, will be confronted with a car lease company that demands an official proof that the other party is indeed an organisation. So the friends need to register at the Chamber of Commerce and they'll need a corporate bank account. The bank, before it is willing to lend the organisation-- to-be any money, will have the human resources-- to-be wearing proper suits and ties and make the university friends fill out standard business plans. All these processes, big and small in nature, further imprint organisationness into the emerging phenomenon. As organisational discourse gets deeper and deeper inscribed, it becomes more and more difficult for the organisation not to become organisation. It becomes progressively difficult for them not to get 'sucked into the attractor basin', so to speak. The forms organisations can take on, organisational behaviour that is displayed, the business ethics that are taken into account, the logics of organisation, in other words, tend to converge towards some prototype organisation. The attractor basin, one could therefore argue, both is produced by and produces organisation.

Exhibit 1

Francis Bacon began his famous *Novum Organum* (new tool of reasoning) with an analysis of the impediments to our acquisition of accurate knowledge about the empirical world (Gould, 1999). Though introduced to account for the barriers to objectivity these impediments also account for the varieties of institutionalism that encourage organisational members toward the organisational discourse attractor basin. Bacon designated such impediments as idols and recognised four major categories - *idola specus* (of the cave), *idola fori* (of the forum, or marketplace), *idola theatri* (of the theatre), and *idola tribus* (of the tribe). Proceeding from the particular to the general, idols of the cave define the peculiarities of each individual; idols of the marketplace designate limits imposed by language; idols of the theatre are based on older systems of thought; and idols of the tribe "specify those foibles and errors of thinking that transcend the peculiarities of our diverse cultures and reflect the inherited structures and operation of the human brain" (Gould, 1999). These sense-making devices partly account for the apparent lack of diversity in organisational behaviour in creating a relatively small set of favoured basins.

Is prediction dead?

Chaos and self-organisation represent two extremes of the behavioural spectrum. What we find is that all other possibilities also exist. A complex system might react proportionately to small as well as large changes; it might also react disproportionately to both small and large changes. In fact, to blur this issue further, apparently distinct and apparently independent domains may emerge within the same system, each adopting a different behavioural regime. This mixing of states is not new to organisation. In an overly simplistic way, a research and development organisation can be seen as following at least two qualitatively different behavioural modes. On the one hand the organisation has its existing product range that must be marketed and sold (this has been likened to an equilibrium state), and on the other hand it has to undertake novel research in order to ensure that its future product range meets future customer requirements (this has been misguidedly likened to a chaotic state). These two differing operational regimes coexist and 'protect' both the present and future survival of the organisation.

The implications of chaos (stochastic and deterministic) and self-organisation (or anti-- chaos) for prediction are not trivial. Naturally, the period for which a prediction is needed is important. Though an analyst might construct a model based upon the behavioural mode that is currently apparent the mode might change. Conversely, it might not. The analyst must wonder as to how

stable the current configuration is such that the model is appropriate. This behavioural complexity does not necessarily require non-linear modelling techniques. The system under investigation may be operating in a linear mode, so a linear description would be perfectly adequate for as long as this mode is persistent. Furthermore, though everything is connected to everything else, it may be possible that the sub-system of interest is reasonably well isolated from the whole to allow a 'hard boundary' analysis. This isolation, or apparent 'near decomposability' (Simon, 1962), will undoubtedly be transient, and may also be illusory, but regions of different stabilities do co-exist within the whole. It is plain, though, that the further into the future one wishes to predict, the more attention that must be paid to the forces that drive behavioural change within the system. Prediction becomes not the ability to foretell specific, well-defined events (in space and time), but, at best, the ability to foretell the range of possible behaviours the system might adopt. This then leads to the development of a portfolio of interrelated decision strategies that can be employed, as future possibilities unfold to become current realities.

In the following, we will explore this into a bit more detail. The concept of non-linearity, we believe, is also a vehicle that brings us to a perhaps more fundamental message complexity science seems to want to get across: a call for pluralism.

Non-linearity as paradigmatic closure

As argued above, boundaries are not as much features of the system itself as they are the result of the act of framing by the observer. Man imposes paradigms onto the world to make it comprehensible. In the case of organisation, a paradigm tells us what belongs to the world of organisation and what should be excluded as irrelevant. But, as we have argued, by isolating organisation, paradigms cut lifelines. The resulting organisation is barely alive - it is separated from all that in which it makes sense. A paradigm produces organisation by putting a stop to the ongoing dynamics of organisational life, by chunking it into organisational concepts, and by taming the meaning of these concepts. Consider, for instance, the concept of Human Resource. The concept of Human Resource is soaked with a specific image of organisation. The concept of Human Resource carries within itself a meaning that contributes to the well being of the organisation, as visualised by a specific paradigm. When the Human Resource is properly organised, it represents the organisation as a whole. Its meaning is fixed and given a weight so that it mirrors what is in the interest of the organisation. Therefore, the Human Resource does not drink, does not surf the internet for personal use, does not grope the secretary, does not yell at customers and so on. Organising is trying to realise 'the qualitative change', described by Juarrero earlier. Once consumed by the emerging organisation, the element abdicates its autonomy. Any evidence that the organisation is not bigger than its elements, its resources show that the organisation has not fully incorporated the resource. The often expressed wish that an organisation should not depend on its resources provides a good example of just that: if the CEO of a firm dies and as a consequence the firm as such ceases to exist, it is often concluded that it wasn't a proper organisation after all. An important aspect of the process of imprinting organisationness is, to phrase it differently, the ensuring that organisational resources can only do so much harm to the organisation as a whole. In complexity science terms, organising can be regarded as an attempt to stay away from the boundaries of the attractor basin. As long as the organisation is not on the 'edge', deviant behaviour of the organisational elements - behaviour not in the interest of the organisation as a whole - can be absorbed by the system.

In general, the presumption that the behaviour of a single element or resource will hardly do any serious damage to the system as a whole is well justified. As was argued above, however, at times, under certain circumstances, small disturbances can have catastrophic effects on the system as a whole. To explore this phenomenon we stretch the earlier assumption that an organisation's boundaries are reflections of paradigms at work more than they are features of the systems themselves. Assuming this, we try to make sense of non-linearity not by accusing the system itself of unpredictable behaviour but by critically examining the paradigms that tell us

what to pay attention to and what to ignore.

Paradigms are useful only when they make the world comprehensible. To realise this they must render the world fixed. As we have already argued, paradigms punctuate, end interactions, and keep them still. From this it follows that 'organisational elements' as we know them do not exist as such until they are somehow called into being for exactly that reason. Concepts are indeed useful limitations to all that life can be. But chunking flux can give us an unjustified feeling of steadiness. The Human Resource is only a Human Resource in the presence of organisation. The various attempts to turn life into Human Resources are never quite successful. Human Resources as single-purpose actualisations of organisationness can rear their ugly heads.

When interactions are organised into organisational resources, they are smothered but not quite killed. Organising, as suggested above, consists of a series of programs that stimulate the emergence of something that is more than just its elements: more than its employees, more than its technology, more than its logistics, more than its building. But when a cheeky banker brings down a well-respected bank, when a computer virus renders a network useless, when an oil embargo immobilises an entire car fleet, when a neighbouring fireworks plant explodes and ruins the local area, we cannot but acknowledge that the discontinuing of the processes that allowed the organisation to emerge in the first place is never fully realised. What got excluded in the processes of reification was never fully hushed. The ongoing dynamics underlying all that was elemented for the sake of the organisation constantly 'try' to destabilize the organisation which it was denied access to by the paradigm at work.

The dominance of a particular paradigm is most likely to lead to a growing mismatch between the conceptualisation of organisation offered by the paradigm and whatever has emerged from the processes left out of consideration. A vivid graphic imagination could offer a picture in which the externalised, unconsidered processes interact to set off the emergence of complex macrostructures unknown to the paradigm that, in the end, WN find their way to the organisation. Consider, for instance, a broker firm. Inspired by its dominant paradigm (e.g. a business model) the broker firm appreciates all that constitutes the Net as something that needs to be addressed because it affects the organisational resource Information Technology. Now, if the broker firm renders all the processes underlying the Net as merely 'the need to have a web site' then the potential emerging superfluity of classical agency as such could go unnoticed. Complexity science could argue that if the Net does bring down the entire industry of classical brokerage it would have made sense if 'only' everything was taken into account. If only everything related to brokery and the Net-ultimately, Wittgenstein's 'world'-was taken into consideration, we the broker could have seen it coming. But this is, of course, ridiculous. He needs to limit, to focus, and to fix meaning. The situation in which he found himself rendering all that constitutes the Net as a mere small disturbance ('it enables us to post electronic brochures') but which ultimately brought down an entire industry (thus being incredibly sensitive to it) cannot be avoided. There is a price to be paid for making the world comprehensible. An important observation here is that non-linearity can hardly be understood as somehow residing within the phenomenon itself. Rather it is the result of our attempts to make sense of the phenomenon. A symptom that needs to be modelled does not like the model. As such, complexity science readdresses Burrell's concerns when he argues that "[...] we must now, at last, turn to the ways in which the stabilisers have attempted to offer momentary glimpses of a world in flux. In this they have forced organisational analysis on to a procrustean bed on which it groans and squirms because it is not the right size to fit the cramping framework into which it is being pressed" (Burrell, 1996: 646). Organisational life itself is not nonlinear; non-linearity stems from our attempts to grab it.

Complexity science tells us that structure of the phase space depends upon the characteristics of the comprising entities and the interactive relationships. If these change (e.g. as we interact with the world our Weltanschauung evolves and so therefore does the way in which we interact with the world) then the structure of the phase space may change. For example, a news report telling us

of the 120% pay rise of a chairman of a failing company is likely to annoy the hard working recipients of the yearly 1.5% pay rise within that same company, likely impacting the structure of the phase space that describes the sociopolitical system containing both the corporation and its employees. At an organisational change level, analysts, consultants, and all people for that matter, must anticipate that the understanding derived from such an analysis, as well as the resulting actions, might change the future evolution of the system under analysis, which in turn might invalidate the analysis, i.e. there must be the 'social awareness' as described in Ulrich's (1983) Critical Heuristics of Social Planning. The fact that current Weltanschauung will in some way shape future outcome is captured in Aristotle's original conception of teleology that presupposes that expectations of the system (e.g. long-term goals) will already be present in thought and direct consequent action and therefore system evolution. Furthermore, the analyst must be overtly aware that the boundaries inferred by their analysis may no longer be appropriate. Indeed, the 'news report' factor may not have been part of the analysis in the first place, existing beyond the analytical boundary. The analytical boundaries are suggested by the paradigm.

CONCLUSIONS: IMPLICATIONS FOR STUDIES OF ORGANISATION

Given that "the world is all that is the case", there is only so much a paradigm can do for organisations. On this point the philosopher Paul Feyerabend said, "Are we really to believe that the naive and simple-minded rules which methodologists take as their guide are capable of accounting for such a 'maze of interactions'" (Feyerabend, 1975:17). No paradigm can include without excluding, can fix meaning without leaving unattended other meanings, can prioritise without marginalising. This observation seems to deny the usefulness for any form of analysis altogether. One way to solve this issue is to call for paradigmless research in which categorisation of any sort must be avoided. This is, however, a plainly impractical and absurd argument. What it does usefully mean, however, is that we should be strongly aware and blatantly open about the provisionality of any perspective that might be utilised in underpinning an analysis of any problem.

Given that no one perspective can capture the inherent intricacies of complex systems, the analysis of complex systems requires us to consider a number of perspectives, i.e. to adopt a pluralist position (Midgley, 1990; Flood and Jackson, 1991). The underlying premise for this is that by exploring a number of perspectives, a richer appreciation of the 'state of affairs', or problematic situation, of interest will be developed. In considering a variety of perspectives, a negotiation, fuelled by boundary critique (Midgley et al., 1998) for example, between these perspectives is encouraged that drives the exploration process. The merits and deficiencies of each perspective are examined in light of both the supporting and contradictory evidence offered by the other perspectives. This evidence may be in the form of individuals' experiences, or Weltanschauung, the numerical output of a particular computer model, etc. As the different perspectives are played against and with each other, new perspectives emerge that are, at least, an eclectic mixture of the parts of the constituent perspectives that seem most relevant to state of affairs under consideration. Complexity, at the very least, reminds us that "this is a time to talk about boundaries" (Lifton, 1970).

Essentially complexity-based analysis is a move away from the contemporary authoritarian style, in which a dominant perspective binds the analysis to a more democratic, or adhocistic (Waterman, 1990), style that acknowledges the 'rights' and value of a range of different discourses. The fairly obvious and often propagated conclusion that organisational analysis should never restrict itself to mono-paradigmatic thinking thus resonates in complexity science. Cross-- paradigmatic explorations and the use of multiple paradigms are crucial.

After years of calls for out-of-the-box thinking, BPR, imagination and so on, a declaration of war on the use of single-paradigm organisation science seems to be a waste of paper. We do not

believe, however, that complexity science arrives at a party where the chairs are already on the tables. Whereas it addresses issues that have been discussed before, complexity science, we contend, is not retelling the same story again. For one thing, it justifies current operationalisations in support of paradigmatic pluralism. For a review of a number of proposed operationalisations see for example Midgley (1997), Vennix (1996), and Richardson et al. (2000). In Midgley (1997) discussion of Flood and Jackson's (1991) Total Systems Intervention, Gregory's (1992) Critical Appreciation, and Group Model Building Vennix (1996), among others, can be found. Though these operationalisations have been designed mainly through practice, followed by a post-hoc justification via accepted philosophical underpinnings, the view of complexity herein offers an alternative way to legitimate such 'meta-methodologies' via rigorous theory.

Complexity science, we have argued, raises important issues by setting out a line of thought relatively unknown in organisation science. In this paper, in a rather 'loose', tentative way we have explored some of the routes complexity science-inspired routes organisation theory can take.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Michael Lissack, Director of the Institute for the Study of Coherence and Emergence, for funding much of the research presented herein.

[Footnote]

NOTE

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[1] It should be noted that the example phase portrait is incredibly over-simplified, using only two

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Subjects:

Author(s): Jacco Van Uden, Kurt A Richardson, Paul Cilliers

Article types: Feature

Publication title: Tamara : Journal of Critical Postmodern Organization Science. Las Cruces: 2001. Vol. 1, Iss. 3; pg. 53, 15 pgs

Source Type: Periodical

ISSN/ISBN: 15325555

Text Word Count 9320