Towards a New Theory of Organisation

From the Perspective of Non-linear Systems Theory

By:

Robert Galavan

Irish Management Institute

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Email: robert.galavan@imi.ie

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1 INTRODUCTION

1.1 OBJECTIVE

This paper will present at a conceptual level the parallels that appear between organisational systems and non-linear dynamic systems in nature. If these parallels can be modelled in an effective manner it would appear possible to provide a predictive formulation of organisations at the statistical level. Given that it is impossible to provide a deterministic prediction this would be a significant development.

1.2 THE STARTING POINT

The challenges faced by organisations at this time are considerable in their debt, breadth, and pace. Organisations of all types face environmental demands of unprecedented scale and complexity. The classical management structures so well described by Weber's bureaucratic model of stability, predictability and control are no longer the ultimate goal for successful organisations. In the unstable fast moving markets that characterise today's business environment, stability, predictability and control are more likely to describe organisations struggling to meet the demands of their market place, than to describe desired models of success.

In the industrial era that developed from the early part of the twentieth century, top down management, controls, innovation, decision-making and control proved extremely effective. This era was characterised by a far slower pace of change, influenced by far less interdependency and organisations were staffed by workers with basic psychological needs. In the era of a connected economy, operating within compressed timeframes, staffed by reflexive workers, dealing with a explosion in communications, challenged by knowledge as a major production factor, competing in increasingly differentiated markets, organisation must develop structures and processes that:

- create and maintain knowledge
- encourage novelty, creativity and adaptation
- allow fast decision making
- carry information and knowledge throughout the organisation
- build intrinsic motivation through continuous personal development

In the light of these challenges it is becoming increasingly clear that the classical models simply do not work. This creates enormous difficulties for many people educated and trained on the basis of assumptions from the classical sciences. Armed with a Cartesian mindset and a deterministic view of the world, it is becoming clear that the world simply does not work the way we think it should. The challenge that we face is not simply to learn about the new sciences, but to unlearn some of the old.

In this paper I am attempting to move beyond the concepts of certainty and determinism that have shaped our understanding of organisations. In doing so I am also conscious that many may see the alternative as phenomenological. Let me make it clear that the alternative understanding I propose is not phenomenological. It does not assume that the failure to explain organisations in deterministic terms occurs as a result of our lack of understanding, our limited capability, or our involvement through the process of observation.

The alternative understanding I propose is based upon the developments that are taking place in the field of non-linear dynamic systems. Related concepts such as self-organisation, autopoiesis and dissipative structures are regularly used today in areas such as cosmology, chemistry, biology, ecology and increasingly in the social sciences. Prior to the development of this understanding time was widely accepted as reversible. Einstein was regularly quoted as saying that "time is an illusion" and it was this strongly held belief that probably kept him from endorsing the theories of quantum physics. If we accept time as reversible (which I do not) then any apparent irreversible properties are brought about through our lack of precision, or through the very act of our observation.

We now understand that a range of phenomena including laser light and chemical oscillations illustrate the constructive role of irreversibility and the arrow of time (Prigogine, 1997:3). Irreversibility and the self-organisation that follows offer us an alternative to determinism that is neither phenomenological nor anarchic.

The development of this argument necessitates a description of the central elements of a non-linear dynamic system (called dynamic system from here on). Once I have identified the elements I will map them onto an organisational system. When this has been done I will develop some of the consequences of this understanding for organisations. This is clearly a conceptual piece of work and there is little research in this area. The final part of the paper will point to key research issues necessary to test the model.

2 HISTORICAL DEVELOPMENTS

Throughout the 20^{th} century we have tried to find the means to 'control' the whole spectrum of activities in which we, as humans, take part. While we have struggled with this challenge as a society, organisations have struggled with a similar challenge in the economic domain. As the connectivity of the world and the pace of change have increased throughout the 20th century, management theory has developed more detailed models to explain the organisational world.

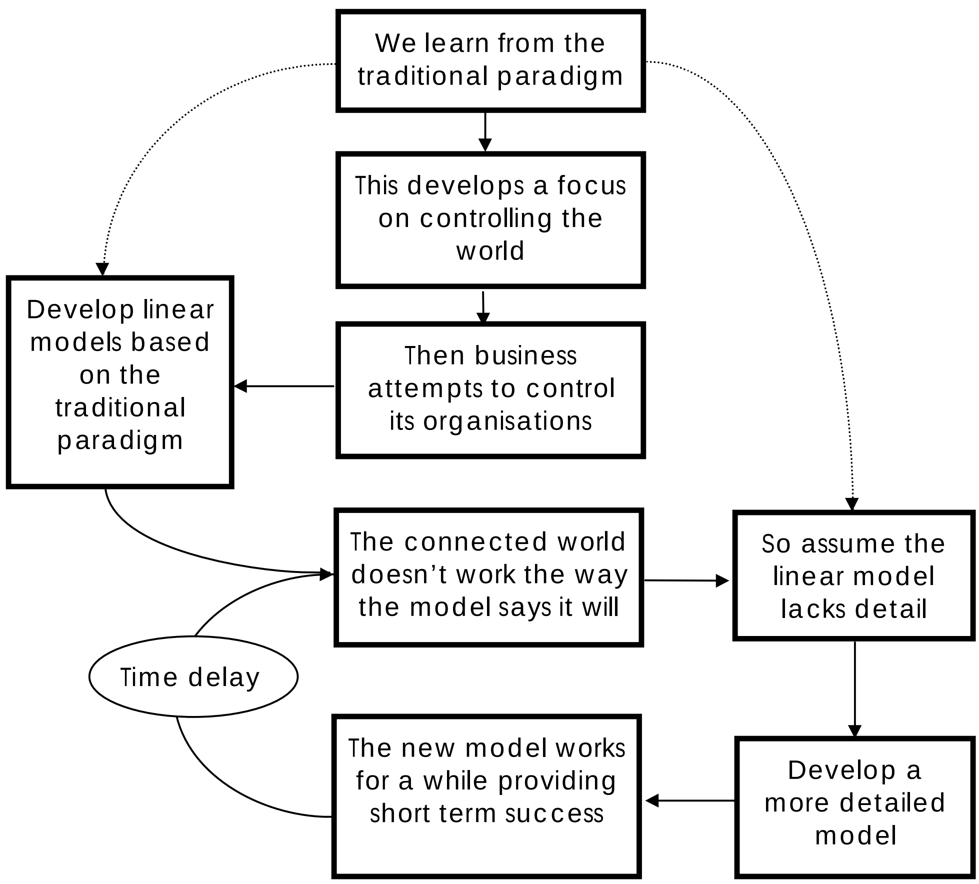


Figure 1 Vicious circle

In an ever-increasing spiral we develop new models and solutions, which in time are found to lack precision or go on to create new problems. The risk with this approach is to drive the level of detail and complication to a point of paralysis. This arises because of the exponential increase in information and decision making brought about by a more connected world. The cybernetic model of centralised command and control simply fails when the threshold of information overload is reached.

Figure 1 shows the viscous circle that we get caught in by looking at the connected economy from the perspective of a linear model. Coming from a linear perspective a model that fails to offer precise deterministic outcomes is a model that lacks detail. The error is usually assumed to occur because of approximations made. When this assumption is deeply held then the obvious correction is to increase the level of detail. What we are beginning to learn now is that increasing levels of detail in a cybernetic model, leads to paralysis.

In the field of organisation theory we have seen significant developments over the last hundred years. Scientific management, classical organisation theory, the human relations school, the mathematical schools, the contingency approaches and a host of other theories have all added to our understanding of organisations and management. This has however been a development from machine models to complicated machine models. Each time we realise that a part is no longer precise enough we add another level of detail in a never ending quest to control the uncontrollable. Importantly, all the theories mentioned attempt to explain the organisation through an understanding of its component parts. As we will see, in physics this approach has been shown to be fundamentally flawed; I believe we can draw parallels in the world or organisations.

3 OUR CHALLENGE

Control from a classical perspective is an ability to regulate and direct; to be able to predict the future and plan detailed actions. At some point as the level of complexity increases it becomes impossible to manage the complicated interaction of an enormous range of variables. Taken from a classical perspective this means that we lose control, and in this classical view lack of control is akin to anarchy.

At the same time we know that it is possible to regulate complex interaction in the absence of classical control. Our societies have developed in generally structured and ordered ways. As societies have become more connected and complex, they find ways of self-regulating through common interest and trust. Certainly there are controls in place, but in a modern western society the population is not 'controlled', and the result while exciting and unpredictable, is far from anarchic. The regulation that exists in western societies derives not from the planning, control and monitoring of all variables, but through a common trust and adherence to a small number of guiding principles and philosophies, and through the development over time of patterns of interaction.

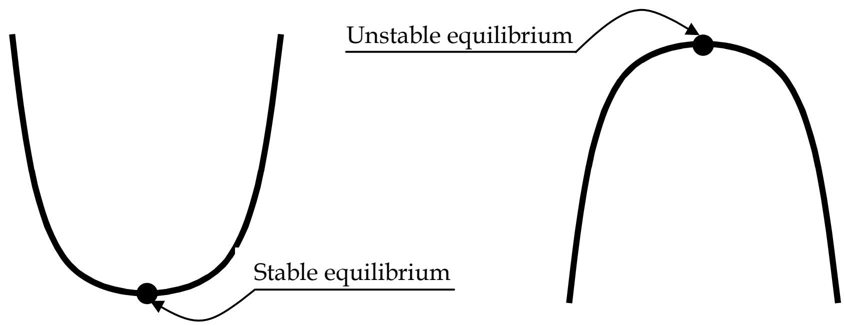


Figure 2 Equilibrium conditions

The environment in which organisations operate today is characterised by pace of change, connectivity and reflexiveness of an educated population. This has changed the character of the stability associated with organisational life.

The technical explanations for this change are developed later. For the moment we say that that the changing conditions bring organisations into unstable equilibrium. Today's organisations are not unstable in the sense that they have no certainty associated with them. Yet at the same time some changes can have uncharacteristically large effects. This can be explained by the change in the nature of stability as shown in

Figure 2. Organisations operating in connected and paced environmental conditions have moved from conditions of stable equilibrium to unstable equilibrium.

As I will show later unstable equilibrium is not an entirely different condition, nor can it be explained by the individual elements of the organisation. Far from equilibrium conditions are a result of systemic properties, properties that exist in the system or organisation as a whole, linked to its environment. At these points of unstable equilibrium we find that small changes can have a disproportionate effect, thus providing the potential for responsiveness and novelty.

I am proposing that as organisational complexity develops to match its complex and unstable environment, as it must for survival, then the control structures must also develop to meet these complex conditions. When I speak of complex conditions in this way I refer to complex adaptive systems that have a dynamic complexity, not complicated systems that have a detail complexity.

The challenge for organisations is to find a means to understand the complex dynamic reactions that shape the environment and the organisation. For far too long we have attempted to find the answer to this problem through understanding the characteristics of the individual elements that go to make up the organisation. Physicists have in the same way tried to explain the physical world through an understanding of the elements.

In order to apply a theory that represents discrete elements, one needs to detach the elements from their environment. To the physicist this means an imaginary ideal set of conditions where no outside influence is exerted on the experiment. To management and organisational theorists this means understanding parts of the organisation in isolation from others, or with limited and 'controlled' interactions with environmental factors.

I propose that while these methods were satisfactory in past stable equilibrium conditions they offer little understanding of how organisations might cope with the current environment of unstable equilibrium. We need to move away from trying to understand the elements within the organisation. We need to understand the properties associated with the total organisational system. These are properties associated with a living complex system that adapts to its environment over time.

These are fundamentally different approaches to understanding, which I believe are paralleled by the approaches to both classical and quantum physics summarised by Prigogine (1997). In classical physics understanding is expressed through particle position and trajectory. In this element based time reversible system, putting minus time into a formula reverses the process, thus making it possible to predict and retrodict once initial conditions are known (Prigogine, 1997:4). Gibbs (1902) introduced the concept of population mechanics into physics. The computational tools Gibbs developed provided for 'statistical probabilities at the system level'. This was necessary because of a lack of understanding of the initial condition of the population. In a large population it was not (at least in any practical way) possible to identify the initial conditions of all the particles. Thus a probability at a system level (in contrast to determinism at a particle level) was a result of ignorance. In other words his theory proposes that problems at an individual level, and problems at the system level are equivalent, and any differences are accounted for by our interference and lack of precision. This type of phenomenological argument is a barrier to our understanding of systems at the population level.

We have come to accept the type of argument that Gibbs made as having almost universal application. That is, when we understand something at the individual level any inconsistencies at the system level are put down to some form of ignorance or lack of precision. We have built our concept of organisations on a similar basis, once understanding individual elements, extrapolating them to understand the totality.

This relationship between the individual and the population or system has now been seriously challenged. This relationship, which is certainly true for reversible systems, no longer stands up to scrutiny in irreversible systems. If we parallel this to our basic understanding of organisations, which is achieved through the aggregation of individual actions, we find a serious dilemma because reversible processes in organisations are a rare exception.

In the past few decades the development of mathematics to support chaos theory, the development of its related field of complexity theory, and the pioneering work of Ilya Prigogine on dissipative structures has challenged this basic assumption that when we understand the parts we can understand the whole. The developments in these fields have brought about an understanding of the effects of instability on systems in far from equilibrium conditions. As Prigogine (1997:35) said that in conditions of unstable equilibrium…"Instability destroys the equivalence between the individual and the statistical levels of description. Probabilities then acquire an intrinsical dynamical meaning. " For us, this means that unstable, irreversible systems (parallel to modern organisations) cannot be described by their individual elements. To understand the meaning of dynamic organisations we need to understand the organisation at its systemic level.

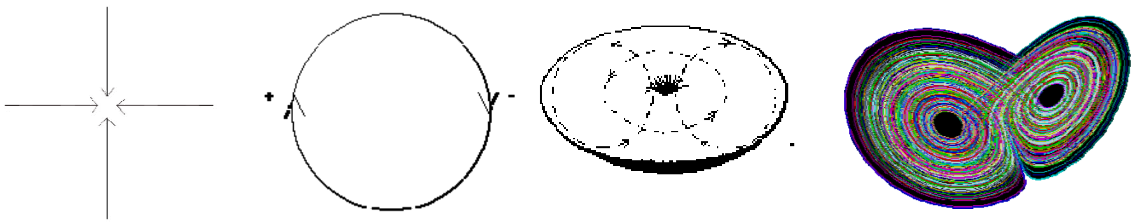
4 BASICS ELEMENTS OF A DYNAMIC SYSTEM

This section of the paper offers a brief introduction to the essential elements and characteristics of dynamic systems. Much of the description is of a superficial nature as I am describing several lifetimes of work in a few short pages. All of the explanations offered are based on sound scientific principles and where appropriate further reading is indicated.

As the study of complexity and chaos theory has spread to a wide variety of disciplines, the number of ways to explain the phenomena has grown. Perhaps I am showing my earlier technical origins when I find a preference to base the explanation in the field of mathematics. This journey begins with the concept of chaotic attractor states and the developmental stages from stability and predictability through to the stages of probability and instability.

4.1 ATTRACTOR STATES

Figure 3 shows four recognisable attractor states. As we move from left to right we move from areas of stability through to areas of instability. Before I provide a technical explanation of the attractor states, we should consider the relationship of these states to organisational systems.



1 – Point 2 – Cycle 3 – Torus (doughnut) 4 - Strange

Figure 3 Four attractor states

4.1.1 Attractors in an Organisational Context

The first two attractors, the point and cycle, are states rarely found in human interactions. The point attractor represents a single state towards which behaviour always converges. The cycle attractor represents a cyclical repeating pattern of behaviours that while not converging, equally does not diverge. Both these attractors are representative of a stable equilibrium where if pushed off track the system will return to its initial state. In this state no learning takes place.

The torus attractor represents an organisational system that while providing a more complex range of possibilities, is nevertheless a stable entity. In an organisation operating at this level one would expect to see rules, regulations and hierarchy. The aim is to have an organisation capable of some limited flexibility, but at the same time maintaining rigid structure. Organisations operating at this level have difficulty responding to rapid environmental demands. They need time to plan, organise, and control change; and can do so effectively if given enough time. This is possible because they are operating in a stable equilibrium, where cause and effect can be determined.

The strange attractor state operates at what has become popularly known as 'the edge of chaos'. The challenge is to keep the organisation on this edge. At the edge of chaos the attractor state provides enough macroscopic structure to enable a functional organisation to develop. At the same time the microscopic structure is fluid allowing for the creation of novelty. This provides a tension between novelty and regularity, similar to the concept of loose-tight controls (Peters & Waterman, 1982). Organisations operating at the edge of chaos can move temporarily into deep chaos, create new patterns and structure as a result of amplifying feedback (small changes having large effects), and then stabilise as a result of negative feedback. The challenge for organisations operating in fast changing environments is to maintain their position at the edge of chaos.

4.1.2 A Technical Explanation of Chaos

We can explain the development of the attractor states quite simply with the use of a common logistic mapping equation known as the Baker Transformation. The Baker Transformation equation is stated as $x \wedge kx(1-x)$ where x lies between 0 and 1. As a logistic mapping equation it takes the result of each iteration and maps the result as the input for the next iteration.

The range of x from 0 to 1 is graphically represented as a straight line. As each iteration uses the output from the preceding iteration the line is folded. The equation takes its name from this process which is similar to the way a baker folds dough. The result is shown graphically in Figure 4. This simple format is "a process of the non-linear, highly complex process known as chaos[1]" (Capra, 1996:124).

[1] For an excellent and accessible development of the mathematics of chaos see Stewart (1989).

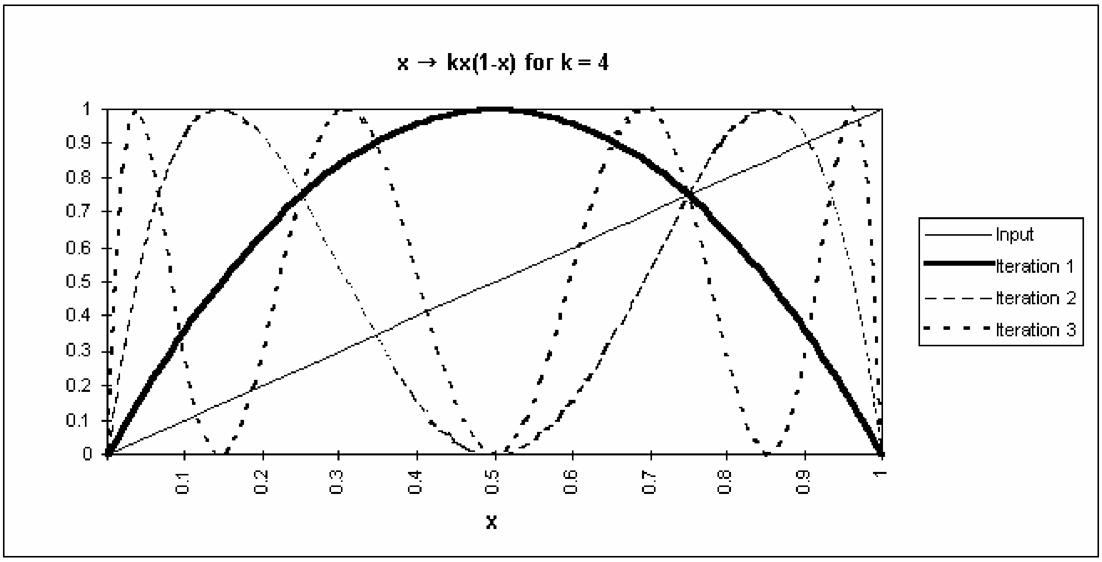


Figure 4 Baker transformation

The resulting plots from iterations with a value for k = 3 and K = 4 are shown in Figure 5 and Figure 6 respectively.

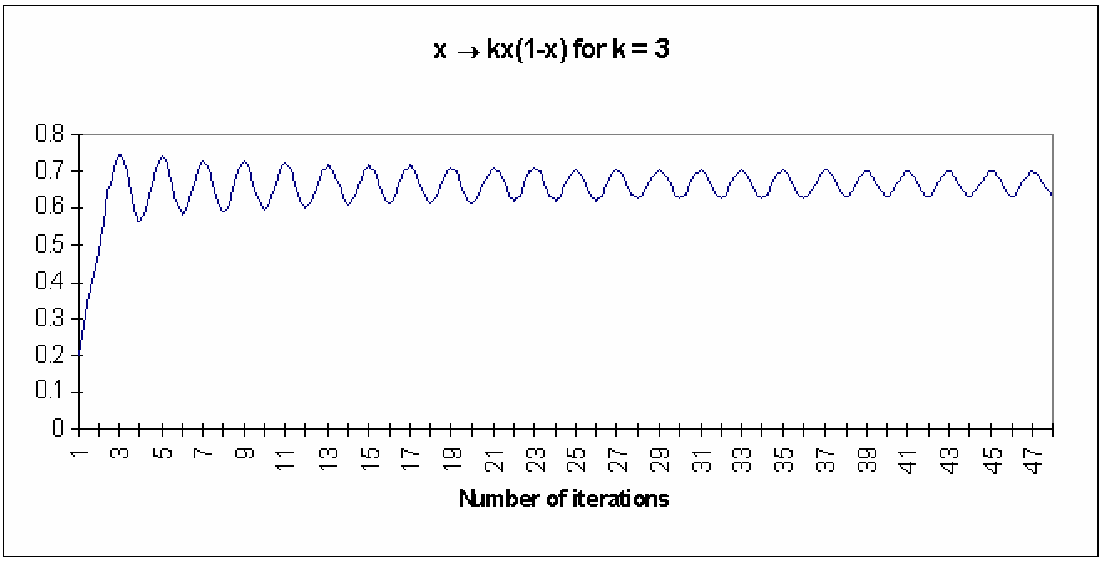


Figure 5 Baker transformation, k=3

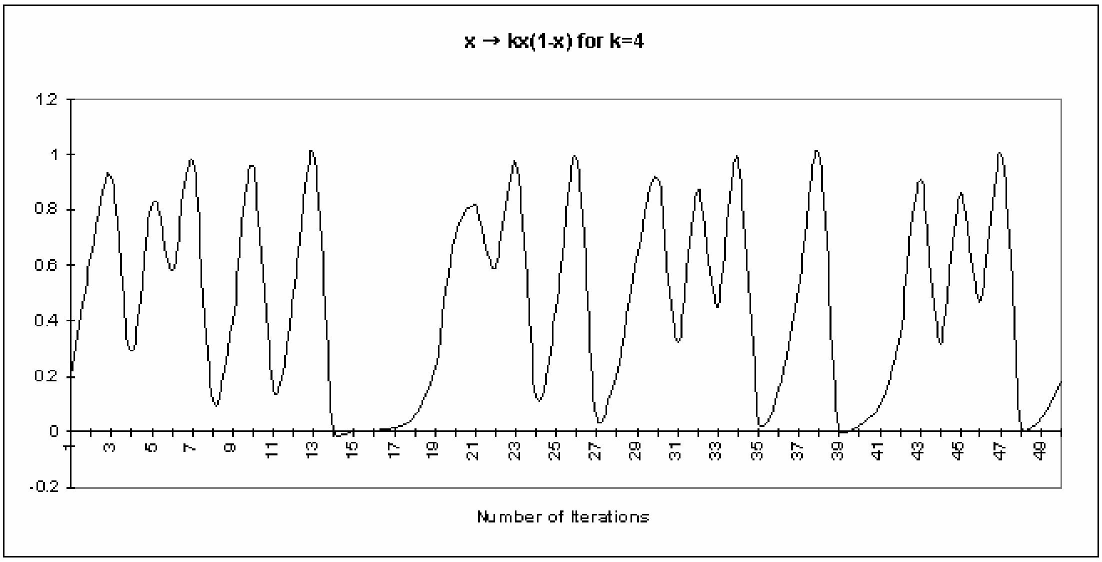


Figure 6 Baker transformation, k=4

As can be clearly seen the results are quite different. When k is at a value below three the result is a steady run down to a stable equilibrium. As k rises the resulting plot becomes chaotic. That is, despite the fact that the equation is deterministic, prediction is impossible because tiny changes in initial conditions lead to wildly diverging results. This is shown clearly in Figure 7 by plotting the results for a point x = 0.2 and a point 1/1000th away at x = 0.2001. As can be seen this tiny difference in initial conditions, when iterated in chaotic conditions, leads to divergent results.

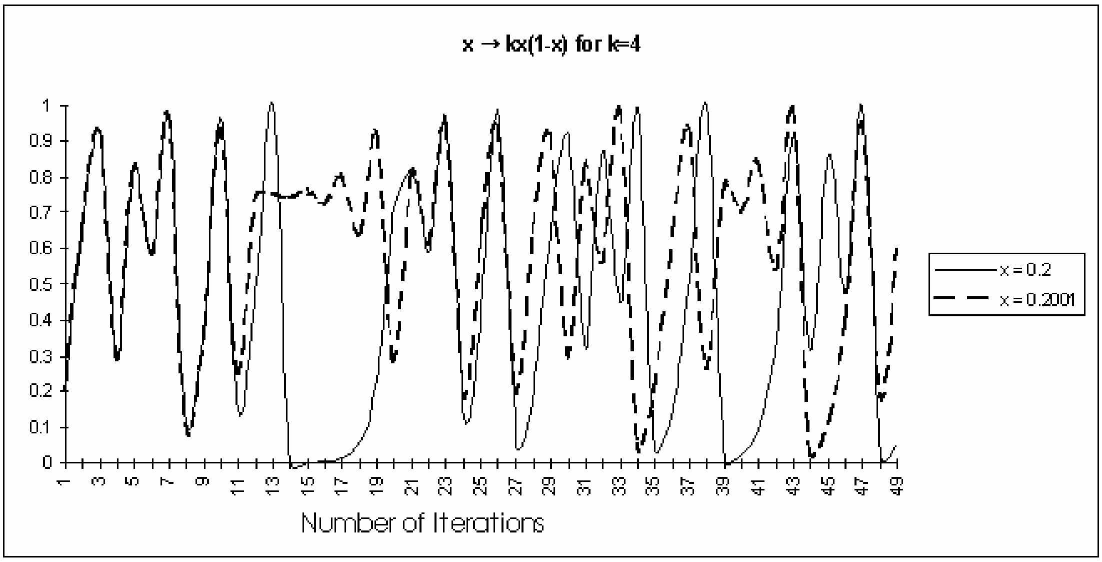


Figure 7 Baker transformation - sensitivity to initial conditions

The changes that occur as the variable k is increased are shown in Figure 8.

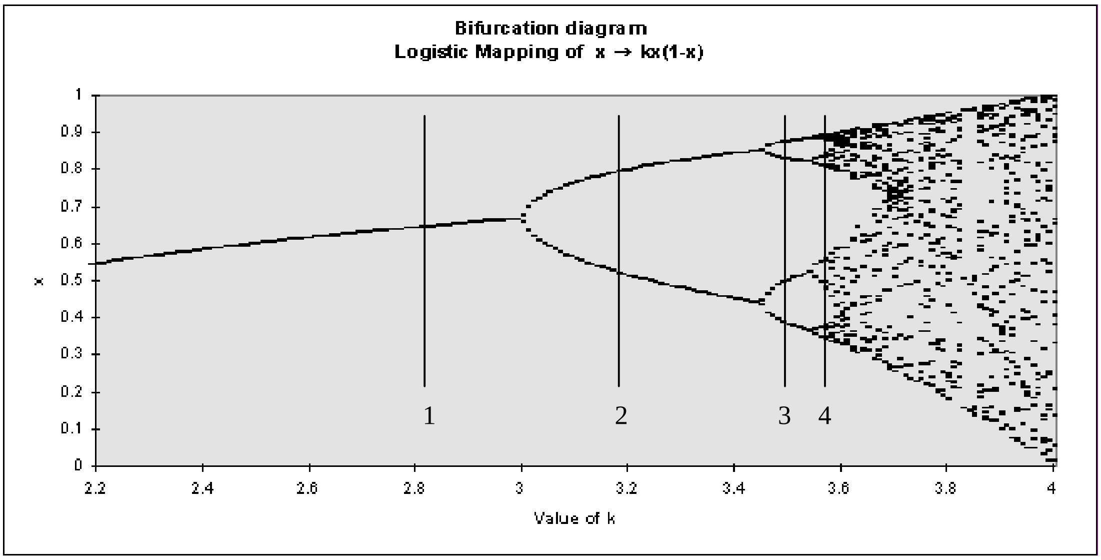


Figure 8 Pitchfork bifurcation

The changes that occur as the value, of k is increased are represented by the different attractor states shown in Figure 3. These changes occur as a branch bifurcates and are more clearly represented as 1 to 4 in Figure 8.

The final point to be identified from the Baker Transformation is the pattern that exists within the chaotic outputs described in Figure 6. Using a simple technique known as the Ruelle-Takens reconstruction (Ruelle & Takens, 1970)[2] we can produce a multi dimensional plot from a single time series. A two dimensional result of this plot from the Baker Transformation is shown in Figure 9.

[2] Also see Stewart (1989:172) for a further development of this technique and the process he terms "fake observables".

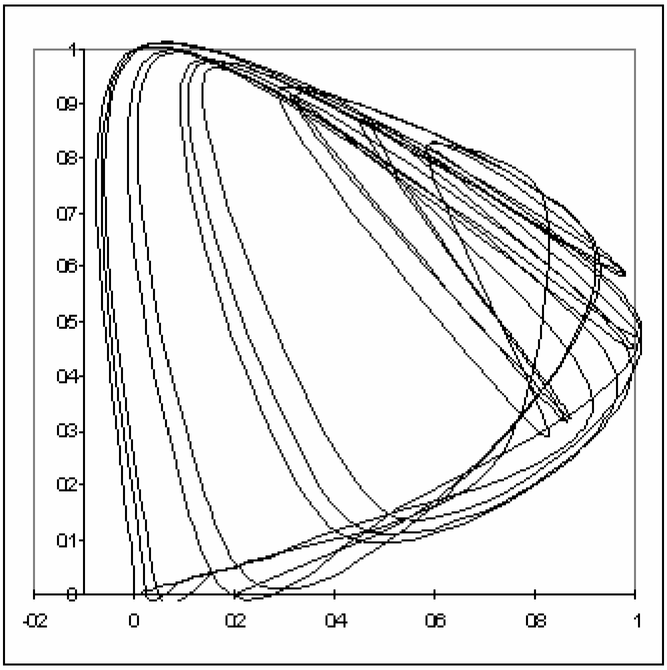


Figure 9 Two dimensional plot of the baker transformation

This is similar to the strange attractor shown in Figure 3. While there is unpredictability associated with the strange attractor state of chaos, within this chaos lies structure and pattern. This implies that while prediction from any single initial point to any future single point is impossible, patterns of behaviour do emerge over time. This is a paradoxical point, for we have a deterministic system that at the component level represents certainty, yet the output of the system is indeterminate and uncertain. At the same time the output will remain within the path of the attractor providing a statistical stability.

4.1.3 Summary of understandings from attractor states

The stability of a system is directly influenced by an external variable (k in the Baker Transformation). In other systems this variable may be represented by energy or information flows. In order to maintain a system far from equilibrium the energy levels in the system need to be increased. In far from equilibrium conditions it is easier for the output to change than it is to remain stable.

When the system is in far from equilibrium conditions it becomes highly sensitive to initial conditions. Any small change leads to wildly diverging results. Therefore attempts to understand outputs through the study of individual elements of the system are doomed to failure. In order to gain any understanding of the outputs their pattern over time needs to be observed at a statistical level. This implies that implications cannot be drawn from instantaneous information. No matter how much we know about conditions at any point, we cannot draw inferences for the future without understanding the pattern of events over time.

So the study of attractor states tells us that systems operate at varying levels of stability. To increase the instability of the system requires the input of energy or information in an organisational parallel. As the information input increases, the behaviour of the system changes through various attractor states, until we reach the edge of chaos. Maintaining the system at the edge of chaos affords us the opportunity to make disproportionately large changes as a result of small input changes. These changes, while indeterminate from an individual point of view, develop structure and pattern when considered at a statistical level over time.

5 MORE COMPLEX SYSTEMS

While the study of attractor states gives a good background to dynamic systems and their properties, it is too simplistic to encompass all the attributes of an organisational system. We therefor need to consider a further range of issues.

We regularly hear about organisations taking actions because of synergy. That is because the sum is greater than the parts. Surprisingly little is known about the properties associated with synergy given the funds spent on mergers in an attempt to create this synergy[3]. From a dynamic systems perspective we understand synergistic properties as those arising at the population or statistical level and that a necessary condition for systemic properties to emerge is the level of energy or information in the system. In our simple Baker Transformation this energy was simply injected through the control variable k. In more complex systems it is not that simple, and a number of additional variables need to be considered.

5.1 NESTING AND CO-EVOLUTION

One of the characteristics of complex systems operating far from equilibrium is nesting. In our simple Baker Transformation we see nesting and self-similarity occurring within the bifurcation diagram. At intervals along the bifurcation we find that the pattern is repeated within itself. In organisations we see systems of individuals working in subgroups that are nested within wider groups, which are nested within the organisation as a whole , which is nested within the environment and so on. Importantly we need to recognise that these subgroups are not interacting with the wider groups. They are inextricably linked to and are a part of the wider groups. No group exists on its own, they gain their relevance only in relation to the other groups.

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[3] "Mc Kinsey and Co. studied mergers in larger U.S. companies between 1972 and 1983 and found that 23% were successful (as measured by the increase in shareholder value) (Peters, 1987:7).

In this way we understand how individuals, groups, and wider groups co-evolve together. That is they co-evolve with co-evolving groups, learning from each other as time passes. We can therefore posit that the level of complexity to which the organisation can evolve is influenced by the relative connectivity of these groups.

Paradoxically we must also consider their relative isolation. If there is complete connectivity and energy or information flows are high (keeping the system highly unstable) then the organisation is likely to fall into anarchy and self-destruct. If on the other hand the energy or information levels are high and the level of interconnectivity between the groups are low (that is the groups are discrete elements) then there will be a great diversity between the groups and the organisation will become dysfunctional. This occurs as the isolation allows the subsystems to develop divergent patterns.

The point is that creativity and novelty (divergence) requires some isolation of individuals and sub groups. If there are no group boundaries or structure and the system is in chaos it becomes dysfunctional as individuals go in diverging directions. If the group boundaries are too strong then the same thing happens as the groups diverge. For coherent organisation group boundaries are necessary to provide the conditions for divergence and novelty. At the same time the boundaries must be permeable to allow the co-ordination of new patterns across the organisation.

Viewed in this way the organisation is a web of interconnected relationships. These relationships can have a variety of patterns, with individuals having many relationships, and being 'a part of' many groups. Sub sections of groups will form relationships with other sub groups and individuals and so on, creating a complex web of interacting. These relationships are normally seen in the informal system, and the current popularity of knowledge management can be seen as a structured response to help these relationships develop constructively. This is done by providing access to organisational knowledge via informal and flexible structures, providing information to people in a format that suits the way they actually work, rather than the way the formal system says they should.

A crude attempt to graphically represent these relationships is shown in Figure 10. It represents the change from seeing elements of the system as objects to seeing them as a web of nested relationships. This parallels with our previous assertion that in order to understand the organisation we must look at the systemic properties. Here we are saying that in order to understand the systemic properties we must see the organisation as a network of relationships. The character of the network or organisation is therefore a result of the pattern of relationships over time and is not derived from the character of the individual elements. If individuals or groups are changed within the organisation the pattern of relationships might conceivably stay constant. Anecdotal evidence arising from the difficulties associated with change management would appear to support this view.

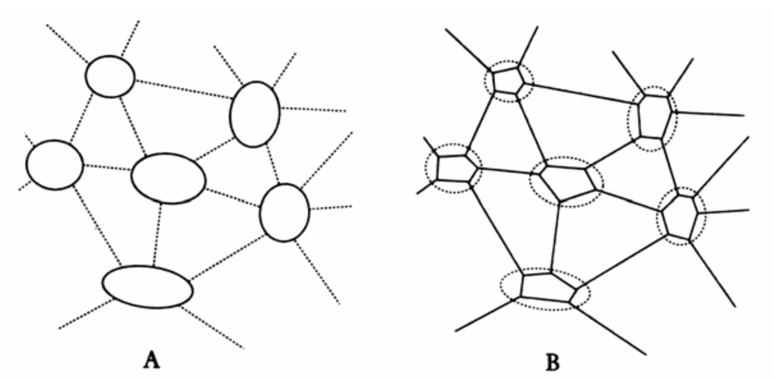

Figure 10 From (A) objects to (B) relationships (Capra, 1996:38)

The management challenge it would appear is to hold the ideas of isolation (or boundary) and connectivity in a form of dynamic tension. This is where a stable framework (within which novel solutions can evolve) is provided by boundaries of ideas and operation, but at the same time these boundaries are permeable. This holds the organisation at the edge of chaos. The boundaries or accepted structure provides negative or stabilising feedback, while the creation of novelty provides potentially amplifying positive feedback. When held at this point some small change if amplified across the organisation can have large effect. The character of the organisation is changed through the changes in the relationships that evolve, and not the individuals or group characteristics.

While there are many other ideas emerging in relation to dynamic systems, those presented so far provide a basis for understanding the organisation at a systemic level.

6 IMPLICATIONS AND RESEARCH QUESTIONS

The broad implication for our organisations is that in order to understand them we must view them at a systemic level. This is not because we lack the necessary capability to understand the interaction. It is because in persistent interactions that involve repeated iteration (such as normal organisational development) we cannot take parts of the system in isolation. Results are meaningful only at the systemic level, and it is at this global level that the time symmetry between past and future is broken. It is this break in time symmetry that creates the true novelty and creativity so necessary in today's organisations. By inference we say that organisational innovation and creativity can only persist where necessary systemic conditions exist to maintain the organisation in unstable equilibrium.

Given that unstable equilibrium is a necessary condition for sustainable innovation and creativity - and ultimately long term competitive advantage – we need to clarify the means to create and sustain these conditions.

Earlier we identified that in order to maintain a system in unstable equilibrium we need to increase the value of energy in the system. This concept is supported by the study of the physical properties of non-integrable systems and KAM theory[4] which states that as we increase the value of energy we increase the regions where randomness prevails. We have paralleled the energy levels in a physical system with information levels within an organisation. From this we can identify areas for research to test the application of dynamic systems to organisations.

It seems to me that there are a number of key factors affecting information levels within the organisation. We need to consider

- The overall level of information or knowledge within the organisation
- The rate of renewal of that information
- The rate of reconfiguration of that information

These factors will be affected by the knowledge base that exists in the organisation and the permeability of the organisational boundary to the outside world. When

[4] See Tabor (1989:104-124) for an explanation of non-integrable systems (systems whose properties cannot be reduced to trajectories because of the presence of resonance or no-local events) and the associated KAM theory.

considering organisational boundaries we must be clear to take into account the informal and social boundary spanning roles that members and groups take on. The flexibility and 'space' that exists within the informal system will affect the rate of renewal of information. A level of freedom of thought and action is necessary to allow organisational elements to conceive, test, and form new mental models. It is from the interaction at a group level of these mental models that reconfigured organisational patterns emerge.

The dispersion of information within the organisation must also be a factor in light of the relative isolation of

- Individuals
- Groups

If individuals are operating in conditions of high energy within nested networks of information they continuously develop novel concepts. If these concepts are tested in isolated circumstances, the development of divergent mental models is likely. While divergence is necessary for creativity, the establishment of this divergence in mental models is counterproductive and can lead to dysfunctional organisations. In a similar way group divergence in isolation creates conditions for the development of divergent social schemas within the organisation. This too creates the possibility of dysfunctional interactions. The task would appear to be to create the isolation necessary for divergent exploration, while maintaining a functional level of convergent mental models and social schemas.

The presence of a persistence factor has already been defined as a key element in determining the emergence of systemic properties. We discussed persistence in terms of an iterative process where outputs of one cycle become the inputs for the next. From an organisational point of view we can see this process as the development of knowledge and understanding through questioning, testing, and revision. The rate of this iteration (the pace of knowledge development) will therefor be critical in maintaining the organisation in unstable equilibrium. While the environment in which the organisation is nested will influence this rate (presuming a sufficient level of connectivity) it will also be moderated by the sense of purpose organisational members share. Consideration will therefore need to be given to:

- The motivation in relation to the individual and organisational task
- The motivation for long-term survival (which is not always congruent with short term tasks)
- The perceived need to keep ahead of changing competitor competencies

For those operating within the system to operate at optimum levels they need to have an understanding of the importance of the systemic relationships. In large part this understanding can be achieved through an understanding of relationships and patterns, both of which humans have an intuitive ability for. Indeed from anecdotal evidence we can see the emergence of leaders in organisations who have a good 'feel' for the patterns and who recognise the importance of maintaining strong networks of relationships.

We can propose a process of learning in these situations where the person or group:

- Obtain some information
- Clarify patterns in the information and relationships
- Reflect on the patterns in the light of existing knowledge
- Give meaning to the new information
- Develop new models
- Act on the basis of the new understanding

The ability of the group to reflect at a systemic level is therefore another variable in the developmental process. We can propose that individuals and groups with broad education and experience will fare better in this regard. Again anecdotal evidence of the difficulties faced when trying to change highly specialised teams would appear to support this argument.

At a broad level we can expect organisations operating successfully in far from equilibrium conditions to :

- Have the ability to hold a paradox rather than solve it
- Have permeable boundaries (and alliances)
- Engage in parallel decision making
- Provide subgroup autonomy
- Achieve focus on task
- Produce flexible responses

6.1 FURTHER RESEARCH

The paper has presented at a conceptual level the parallels that appear between organisational systems and non-linear dynamic systems in nature. If these parallels can be modelled in an effective manner it would appear possible to provide a predictive formulation at the statistical level. Given that it is impossible to provide a deterministic prediction this would be a significant development.

It would appear that the first step is to validate the parallels drawn during the course of this paper. In this regard it seems logical to validate the effect of enabling conditions. To begin with we might consider the impact of:

- The information levels (the potential and actuality)
- The rate of renewal of information (inward flow across boundaries)
- The rate of reconfiguration (change in the absence of invention)

It would also appear logical to clarify the impact the differing levels of connectivity have on the diversity of information created and its integration into organisational patterns. Including:

- Individual to organisation
- Sub groups to organisation
- Sub group to sub group
- Individuals to external groups
- Individuals to external individuals
- Organisation to organisation

At a broader level we should consider the organisations willingness to maintain paradoxical tensions as valuable assets rather than continually trying to solve them. Once the paradox is solved does the reduction in tension or gap remove the need to learn and thus remove a key enabler of non-equilibrium. We must also ask are there destructive tensions as well as constructive ones, and can they be codified?

How is the organisations ability to remain in unstable equilibrium dependent on external relationships? What type of connection must the organisation have for optimum effect? The danger would appear to be that as organisations create more permeable boundaries they risk loosing their own identity. How can we identify or recognise that danger zone.

This view of an organisation as a dynamic system, if accepted, opens up a myriad of questions on leadership and the psychology of work, none of which are addressed in this paper. If individuals work in organisations to rid themselves of some of the anxieties of dealing with the world, how do leaders protect them from those anxieties while at the same time maintaining responsive organisations? What options do leaders of the future have other than protecting them from the anxieties by providing closed boundaries? Can we have bottom up strategies without individuals dealing with the anxieties of a connected world?

The importance of this issue means that this agenda cannot be ignored. It can be tackled through the verification of a dynamic process model of organisation. Once successfully established, a model that provides an understanding of organisations at a statistical level can be used as a base to develop a model for leadership in turbulent conditions.

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