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# The viability of using various system theories to describe organisational change

Organisational  
change

43

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**Abstract** This article discusses the viability of concepts such as complex systems theory, evolutionary theory and chaos theory as metaphors for being able to give a global perspective of one particular school described in a previous article entitled "Leading people in a chaotic world". The article restates and re-explains this one particular case in question and offers a rationalisation for using chaos theory as part of a much larger theory of evolution and complexity. The argument restores the overused and popularised chaos theory to its more useful place as an emergent phase in the decision-making and subsequent change phase of the evolution of complex systems. In so doing, the paper points out that the use of chaos theory alone as a set of management rules for any school was never the intended implication to be derived from this particular case. Instead, the intention was to create a description of the changes in one particular school organisation stretched across time and space in which its structures and processes were continuously evolving in unpredictable, sometimes chaotic, but always complex directions with other structures and processes inside and outside the school.

## Introduction

In the early 1980s, advances in computing and the subsequent development of new ways of observing and interpreting various interrelated phenomena in the physical sciences enabled mathematicians and scientists to develop a theory of change called chaos theory. The concepts of chaos theory were immediately popularised in the 1980s and early 1990s because of their novelty and apparent diverse applicability. In so doing, speculation of their applicability to the social sciences was also highlighted. There were many attempts to outline a theory for everything, a search for the underlying characteristics in the whole of nature including the human nature of individuals, groups and organisations (Briggs and Peat, 1984, 1990; Gleick, 1988).

By the mid-1990s, more was understood about the process of chaotic change and the various systems in which it had been observed. Eventually, many of the complex human social systems previously studied were found to be systems that passed through occasional chaotic phases as part of their evolutionary development.

According to mathematical modelling and simulation experiments, a system must reach a certain threshold of change rate before it avalanches into chaos. Chaotic systems tend to be deterministic systems that evolve through a particular phase of instability and eventually achieve another threshold where



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a new relationship is established between its internal and external environments and itself (Lorenz, 1993). We speak of a chaotic phase as evolving from order to disorder and through to a new order.

Often, the application of chaos theory, evolutionary theory and complex system theory as metaphorical descriptors for certain aspects of educational organisations that are evolving through certain phases of change is incomplete, inaccurately applied and inaccurately interpreted. However, the nature of the investigative process and the growth of knowledge are characterised by our attempts to match imagined analogies, metaphors and models with the real world in our quest for more descriptive and more complete explanations.

Such descriptors remain one of our commonly used tools for making creative leaps in understanding our world. In consequence, Galbraith (2004) has voiced some concern about the application of chaos theory to aspects of educational administration.

### **The viability of using theories as metaphors**

The use of system dynamics with its mathematical modelling and equations to make predictions that take into consideration every possible influence is currently not feasible. Even if computing simulations greatly advanced in technological complexity, there would still be an infinite number of possible influencing variables. In agreement with Galbraith (2004), chaos theory can not be used to develop specific management strategies for the day-to-day work of educational administrators or rules to implement minority supported policies by designing some devious butterfly effect that is guaranteed to propagate acceptance. The possibility always exists that some unpredicted influence may be activated and change the processes taking place.

A more global metaphor concerning organisational evolution (Jantsch, 1989) is necessary in order to appreciate the applicability of chaos theory. It is more useful to think of a school as being in continuous evolution over longer periods and across larger networked spaces. Such evolution consists of adapting or constructing structures and processes to maintain harmony with various combinations of internal or external stimuli.

There is a leap in an evolutionary process when a certain adaptive threshold is reached and the structures and processes cascade into a new equilibrium that is different from previous adaptations. Such a creative bifurcation that reaches a new equilibrium in the evolutionary process is called a catastrophic fluctuation. Chaos theory can help explain these sometimes chaotic punctuated phases of the much larger process of evolution. However, as explained above, any description must necessarily be an incomplete description. This is why we need metaphors to imagine as many aspects of the global reality as we can.

The main thrust of "Leading people in a chaotic world" (Sullivan, 1999) was to discuss the viability of such necessarily incomplete descriptions and explanations at being able to support an increasingly global understanding of

organisational evolution in schools. Leaders need theoretical tools to describe this perpetual evolution in order to understand their organisations and lead effectively. The link between complexity and computer simulation might give administrators and leaders the background wisdom to understand the infinite possible scenarios that result from the evolving variables present (Sullivan, 1999). Other than this, there is the researcher's imagination.

A description of evolutionary theory and chaos theory can help researchers to imagine what occurs during certain phases of change and what occurs during the process of individual and group learning in developing learning organisations. The descriptors are intended to explain overall patterns in such phases. They are not intended to describe specific situations, nor are they for predicting future outcomes of specific situations and they are certainly not intended to generate specific strategies for managing specific situations.

The global nature of such descriptors also creates a sense of synergy, of connectedness and belonging between the members as well as a holistic learning by the organisation. Such synergy is found in a learning organisation that seeks alignment informed by systemic understanding, together with collegiality in leadership and management, in the search for profound and sustainable change (Galbraith, 2004).

If a description of a complex organisation uses the language of mathematics, complexity, evolution or other system theories, then maybe that path is a fruitful path to greater understanding of those aspects. Openness to further analogies is one of the keys to learning.

However, one should always be careful when using descriptors of one type of phenomenon to describe the characteristics of another. Objects of study may appear to have the same structure or processes but this does not imply that the objects or phenomena are the same in all respects. This is why a metaphor is not a perfect fit for all aspects of a phenomenon under study. It aids in the explanation of certain phenomena only.

### **Parameters for using theories as metaphors**

Sometimes, intersecting influences inside and outside the school can create rapid and overbearing change. Stress in management, crisis management, planning and policy making, have all been highlighted as priority issues in educational administration. Driving this interest has been the question of how best to cope with such uncertainties in a leader's day-to-day dealings.

Many of these studies involving change and upheaval have tended to view schools as having a high level of complexity, non-linearity, turbulence and unpredictability. In particular, the decision-making phase, which governs most change sequences, has come under scrutiny. The decision-making phase of change generally begins with critical and ambivalent change and unpredictable upheaval until enough information is understood in order to make a decision. This process of becoming aware is an individual and organisational learning process (Leithwood *et al.*, 1995; Senge, 1990).

During decision making, individuals and groups may experience intermittent ambivalence and unpredictability. The consequences of such organisational behaviour are that not everybody understands what the others are thinking or experiencing at any given time. As the irreversible change sets in, people may feel turmoil in their environment and in their own perceptions. Such a situation may at times appear similar to the organisational behaviour of chaotic systems.

At any given time, in any given place, we may observe a seemingly unpredictable upheaval in an organisation and imagine it is a random extraordinary event. Yet these extraordinary events are relative to one's individual perspective or location in the whole organisation. We perceive only part of the picture when we judge specific events from a specific perspective as being extraordinary.

From a global perspective, the whole system can be understood as being in a continuous metamorphosis. The supposed extraordinary event can equally be interpreted as an occasional chaotic phase in a continuous evolutionary process. It is an evolution that can be described as leaps and bounds of punctuated and fluctuating catastrophic equilibriums occurring at various points of leverage throughout the system (Bak, 1997).

This global understanding is needed to appreciate the concept of a learning organisation and can only be achieved through being connected to a global communication network within and beyond the school. The metaphor of chaotic phases within an evolutionary framework can be useful when dealing with upheavals in schools because it helps us to imagine such schools as continuously in a self-referential, self-organising state as they sporadically learn from past experiences and so adapt to new inputs.

### **The incompleteness of mathematical models and simulations**

Mathematically, certain variables can be artificially eliminated or controlled and the change phases can be simulated. However, in the real world, all variables cannot be controlled and the whole system can only be partially simulated or observed.

Caution needs to be taken when attempting to apply mathematical models of non-linear systems or direct observations of change in schools. At best, such methods of enquiry can only approach an approximation of reality. This shows in the example of Galbraith's (2004) simple non-linear system model of the problem of matching teacher supply and demand.

Simulating the full complexity of even quite small dynamical dissipative non-linear systems will have to wait until a far more efficient form of computing can be invented. Coveney and Highfield (1995) have documented these recent developments. Interestingly enough, teams of scientists from many specialisations are progressing along the approach of integrating biological and evolutionary structures and processes with the technology of electronics

and light. They aim to produce forms of artificial intelligence that emulate consciousness in the living brain.

The direction in which they are developing technology is based on the assumption that the organisations in which we go about our daily lives are indeed complex. Not only do layer upon layer of sub-groups interact within our schools but also these same organisations interact with the myriad organisations that form the whole of society. Such continuous interaction at all levels in our educational organisations is part of a giant network which is in a state of flux (Sullivan, 1999).

This is why laboratory experiments and simulations do not always yield the same data as observation of actual groups in their natural settings. More to the point, the experiment or simulation creates specific theoretically relevant aspects of specific social situations under controlled conditions. That is to say, their purpose is to construct and test theories about abstract representations of specific aspects of the real world.

The real world has extra variables that may not have been considered in the experimental or simulated environment. As Coveney and Highfield (1995) point out, mathematicians, scientists and social scientists are placing great hope for the future on the integration of mathematical models and simulations and the use of metaphor and analogy to understand our reality more completely. It is a holistic approach, which integrates the sciences with the humanities and philosophy. The approach has an artist's-philosopher's touch just as much as it has the conventional scientist's touch.

### **The use of metaphors to fertilise the imagination**

Theories of complex systems, evolutionary systems theory and theories of systems that are in chaotic phases are all useful ways to imagine the vast complications of organisational behaviour. That a theory is necessarily abstract derives from its origin, which is the imagination of the researcher philosopher.

When a system is imagined as evolving over time, global maps of the changes taking place or the dynamics of this evolution need to be intuitively portrayed because all the exact details are too complex to observe directly and fully document. These global maps or descriptions act as metaphors of the organisation as a complex system and as part of a much larger evolving complex system and so give meaning to any data collected.

The report of the one particular school organisation in "Leading people in a chaotic world" (Sullivan, 1999), used such a systems metaphor to give meaning to the outcomes of the strategic management taking place throughout the policy implementation. It was not used as a recipe for management action. At best it only suggested guidelines about the nature of appropriate management principles.

In "Leading people in a chaotic world" (Sullivan, 1999), the use of metaphor was retrospective because the complexity of the processes could only be partially grasped in real time and after the event. Such theories are descriptive rather than predictive. They enable global vision rather than reductionism. Further, in agreement with Senge (1990), they ignite a cognitive pathway toward a deeper appreciation of the unity of systemic networks, a collaborative concept of leaders and followers in teams, and the learning organisation concept.

The kind of global systems thinking, which Senge (1990) imagines, is as global as one can imagine. We can imagine wider than a global perspective of a single organisation to a network of co-evolving systems. We can imagine an even wider perspective to an extremely complex network of networks whose interrelationships are far too complex to imagine.

### **Imagining the context**

The main metaphor that was used in "Leading people in a chaotic world" (Sullivan, 1999) was to imagine the function of a particular policy in a learning organisation as acting like an attractor. This does not necessarily mean that the policy was an attractor in the physical object sense. Rather, it acted like an attractor because it was the focus or vision to which the system was being drawn through the process of individual and organisational learning. The policy developers intended that any change would be toward an internalisation of an adaptation of the ideal reality described in the policy content. This was presented as something for them to explore, discuss, adapt, assimilate and internalise to whatever level they felt comfortable.

In consequence, the initial response was that some accepted the ideal reality; some influenced changes to the ideal reality; and still others openly rejected it. Such controversy resulted in a mismatch of conceptualisations and quickly developed into a disorder, which finally evolved into a new order where a modified form of the ideal reality was eventually accepted throughout the school community. The policy initiated self-referential communication behaviour. It was this behaviour that acted as an attractor. The self-referential communicative influence was likened to a chaotic attractor because of the disarray and unstable oscillations that took place until some common ground was reached.

These oscillations occurred because the policy was implemented in a particular free-form culture that was driven by total consensus. In this particular context, a conscious decision was made to accept conflict of values as a positive characteristic of individual and organisational learning. The staff had long been deeply entrenched in free thought and had been together for a number of years. The implementation process was planned to encourage the implementers to adapt the policy content to their own philosophies of education and life in general. In practice, most target groups are not granted this gift of

individual expression. Instead, policy implementers usually confront a significant degree of authoritarian coercion for direct adoption rather than be allowed to find their own ground.

The staff had already developed strong learning organisation mental models. The school staff comprised a genuine small community of professionals. Their interrelationships and interactions were based on a consensual trust and confidence that individual members would make responsible and accountable decisions based on what they considered was appropriate for themselves and their organisation as a whole.

As part of a learning organisation strategy, the researcher mapped the changing processes and structures as the policy was implemented so that the research report gave meaning to the data collected. By reflecting on the dynamics taking place in terms of concepts such as evolutionary theory, chaos theory and complex systems, the staff grasped a better understanding of their individual and organisational learning.

Individuals were learning different things about themselves, others and their organisation at different times. This is why it was not necessarily a chronological or linear study, but an analysis of its learning dynamics. A clarifying point here is that the use of the word dynamics does not refer so much to the discipline of system dynamics but more as a term to characterise the continual morphing of the system and its wider networked systems (Lorenz, 1993).

The particular school and policy described were unique and could have been more prone to chaotic disturbances than would be normally expected for schools and policies in general. This is probably because rather than be a directive policy about how to do something, the leader presented the policy as a sounding board for individuals and groups to further evolve their philosophy of education and way of life in general. They were actively encouraged to take their organisation to a certain threshold of change where views would oscillate in a chaotic manner until a new view of their choice was internalised by all.

Although such a strategy could be considered a risky management strategy, the management was seeking learning not control. The policy was designed out of the input of the wider global community to which the school belonged and embodied the general philosophies of that community. Rather than coerce staff into accepting the community's philosophies that were imbedded in the policy, it seemed more appropriate for individuals to find common ground with their community's culture. A policy implementation process of this nature seemed more aligned with authentic individual and organisational socialisation and professional learning.

The educational leader firmly believed in freedom of choice, demonstrated an absolute faith in the staff and implemented a process whose outcomes would be more morally satisfying than other more directive policy designs and implementations. It was an experiment, which appeared to cause considerable

chaotic tension at times but finally achieved its aim of co-evolving the policy and the community.

In this particular case, describing the policy as a chaotic attractor may have been more than just mere metaphor. The substance of the self-referential communication was the substance of the policy. In this sense, the policy was a chaotic attractor because the controversies generated by its content principles generated the controversial self-referential debate into which all the staff were drawn to participate. It is noteworthy that the policy implementation process and the descriptors and concepts used to describe the change that took place were not and still are not generalised to other educational organisations or policy implementations as far as the author knows. However, it must be remembered that whilst case contexts are unique, who is to say that there is no possibility that a similar structure and processes could not occur in other organisations?

Cambel (1993) discusses the term attractor as a state of behaviour, which is represented mathematically as a phase space, to which a system evolves closer and closer in appearance and behaviour. The ideal reality embedded in the policy content was a set of value-laden characteristics that recognised the individual ideal professional educator in his or her ideal and unique context. It was this ideal state to which the school community was evolving closer and closer in appearance and behaviour.

The individuality of interpretation of that ideal reality and the subsequent practice that was taking place during a certain phase in the implementation process was observed as evolving in a highly irregular way. The form and direction of individual and organisational learning was sensitive to individuals' initial conditions in that people were expected to explore, discuss and reflect on the policy content before adapting and internalising their interpretations of the ideal reality. Individual systems started from different sets of points in phase space and evolved into patterns of chaotic disorder through to some form of related order.

Consequently, the implementation process appeared to be random but with an overall global pattern. The dynamics appeared to be unique, never completely repeating themselves and resulting in divergent and unpredictable states for each individual and for the organisation. The dynamics appeared to be analogous to a chaotic attractor whose phase space is stretched, contorted and diverging along irregular evolutionary paths before evolving into new phases (Cambel, 1993).

### **Expanding the imagination**

The school was part of a co-evolving network of systems that formed a global multicultural reality. It made reasonable sense to imagine certain desirable realities as forming pools of attraction for the network of systems. These pools



of attraction comprised a number of symbiotic emergent paths which determined the general evolutionary direction of the school (Lorenz, 1993).

This form of system metamorphosis may superficially appear as if the spread of communication and resultant action are passively following the path of least resistance through surrounding weaker influences (Galbraith, 2004). However, there is more to the process that Lorenz (1993) believes has been rather vaguely labelled by many writers as the “butterfly effect”.

The rapid spread of communication and action throughout a system may well be a proactive process of all parts of the system re-configuring their relationships throughout the network. This re-configuration can lead to wild oscillations and resultant chaotic bifurcation in the direction of change. Such a process would make guaranteed accurate prediction impossible because the whole network is continually evolving. Future influences may not even yet exist because some currently unrelated part of the network has not yet reached a crucial phase in its own evolution and significant events can go unrecognised and unappreciated.

In most organisations, the type of policies, rules and regulations as discussed in the paper “Leading people in a chaotic world” (Sullivan, 1999) that affect the structure, processes and overall culture, are proactively guiding the evolution along predetermined appropriate pathways and dampening radical deviations. Consequently, these policies do not usually allow truly professional collaborative groups to fall prey for very long to dictatorial managers who would make the type of sweeping changes envisioned by Galbraith (2004), that is “megalomaniacs who would introduce bizarre policies on the grounds that a flap of their wings will create an organisational thunderstorm to change the face of the future”.

This is why the strategic management spoken about in “Leading people in a chaotic world” (Sullivan, 1999) is not the strategic management of control of a specific situation but the strategic management of maintaining a learning organisation. Maintaining a genuine learning organisation founded on free will and individual and organisational responsibility would only be a high-risk strategy for leaders who feel the need to keep control of situations. This is because they would know that one person or one group does not usually control the evolutionary process for very long without the acceptance or compliance of others.

Another issue raised by Galbraith (2004) was that disorder might indicate inept management. However, disorder is often present in the problem-solving process before a solution is achieved. Chaotic phases occur in a true learning organisation because disorder often surrounds people’s perception of a particular issue before understanding and reflective learning set in.

The principles and ethics involved in maintaining a free consensual learning organisation, dictate that any outcome is dependent on collaborative decisions by responsible and accountable professionals at all systemic levels. The actual

outcome and its consequences may not be fully understood at the time, but in a learning organisation it is the journey that is emphasised precisely because the complexity is too unpredictable and sometimes chaotic to be fully understood.

Yet another issue raised by Galbraith (2004) was that signs of disorder may indicate a permanent or fatal disability within an organisation. This may well be true for a single organisation but not necessarily for its larger system. Signs of disorder in one school might well be signs that the whole system of education is healthy and on its way to a much improved new order (Sullivan, 1999). One example of such a situation might occur during the closing down of a cost-draining part of an educational system. The specific school may appear to be in disarray and disorder as economic, educational and social influences are shifting to other priorities within the entire system. Yet from a global perspective, the saved costs enable other more needy areas to flourish. Localised disorder turns out to be an improvement in relation to the whole system.

### **Leading people in a chaotic world**

It is important to appreciate the parameters for using chaos theory as part of a larger theory of evolutionary development in order to support the explanation of change in complex human social organisations. Recent awareness of the similarities and behaviour of many living and non-living systems and their interrelationships has led some mathematicians and physical and social scientists to explore just how wide an applicability certain systems theories do have (Bak, 1997; Briggs and Peat, 1990; Capra, 2002).

In his book, *The Living Company*, De Geus (1997) describes a form of management that has a strong sense of community with common values and mutual support. This management is also open to the external environment with a sense of tolerance for new circumstances and an ability to adapt to new circumstances. The leaders who direct such a form of management are characterised as facilitators of emerging novelty. They create conditions for individual and organisational learning. They nurture the organisation by supporting their staff in their creativity and their learning during their change processes. They hold and share a vision that fosters the emergence of experimentation and learning through mistakes as well as successes. They maintain a high level of personal and professional group competence, develop a common self-identity as a learning organisation, share a common vision through the establishment of communication networks and work and learn in teams. Such ideal leaders implement specific leadership strategies so that their evolving learning organisations can leap from one level of equilibrium to another. This is very much the idea of the learning organisation (Leithwood *et al.*, 1995; Senge, 1990).

Depending on how we define a living system, we can use the metaphor of a living system to describe our complex networked human social organisation as

an evolving living company (De Geus, 1997) that has the self-referential, self-organising ability to learn. This living system also has the creative ability to self-transcend its current structures and processes and to metamorphose into unpredictable new equilibriums.

An open human social system is a highly complex network comprising of many individuals, each with their own intelligence, each affecting particular stimuli and responses within the network, which ultimately affect the direction of evolution of the entire organisation. It is this sheer complexity that makes the system non-linear and unpredictable. Furthermore, the system's structures and processes that govern its behaviour are founded on successful adaptations to past events. Its past evolutions are imbedded into the very fabric of its existence and influence its current state of evolutionary development. In addition to this organisational memory imbedded into its structure and processes, this human social organisation has the memory of every individual member and a group memory that gives rise to an emergent form of consciousness that biases certain directions of change. In other words, this complex system is like a living learning organisation that adapts its construct upon reaching a new equilibrium.

### Conclusion

When using global concepts associated with complex evolving systems, one is attempting to describe a very complex, dynamic not static, unpredictable and sometimes chaotic deterministic process of co-evolution. One is not predicting future states of an essentially unpredictable evolutionary system and one is certainly not predicting specific future states and prescribing specific strategies of change to the existing structures and processes.

By using metaphors, such as evolutionary theory and chaos theory to describe the structures and processes involved in complex change, there are implications for the nature and ethics of leadership. At some point in people's individual and organisational learning, a certain global understanding of the complexity leads people to appreciate their place in their global network. When they see everything rather than just themselves, they may develop a mature philosophy concerning leaders who are prepared to take the ultimate risk of releasing control and taking people with them on a journey toward mature free will. In this sense, the ethical dimension of such mature leadership becomes, for want of a better descriptor, spiritual.

Access to education is a basic human right. An educational leader's goal to achieve that human right for others is the goal to provide the most effective education that is practical and possible in the given local context.

This is why Sungaila (1990) imagines ideal leaders as those who have internalised universally accepted moral and ethical practices. They are courageous, heroic and compassionate about the rights of others and themselves to maintain such practices. They are intent on rectifying people's

rights and potentials that have been inhibited. If not such leaders, then they are like dictators protecting their own rights whilst content to criticise such imagination of what educational leadership and educational organisations are or could be.

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