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How to cite:

McMillan, Elizabeth (2002). Considering organisation structure and design from a complexity paradigm perspective. In: Tackling industrial complexity: the ideas that make a difference (Frizzelle, G and Richards, H eds.), Institute of Manufacturing, University of Cambridge, Cambridge, UK, pp. 123–136.

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Considering Organisation Structure and Design from a Complexity Paradigm Perspective

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1. ABSTRACT

This paper argues that the nature and importance of organisation structure and the underpinning design principles are not well understood and yet they play a key role in organisational performance. Existing organisational forms and their design principles are examined via a brief history of the development of modern forms of organisation. There is evidence to suggest that classical science has provided many of the underlying principles for organisation design. Comparisons are made between design principles derived from the classical scientific (Newtonian–Cartesian) paradigm and the complexity science paradigm. A speculative model of an organisation structure based on design principles drawn from the complexity paradigm: 'The Fractal Web', is presented. In concluding it is suggested that the use of design principles derived from the complexity paradigm offer a way forward that will facilitate the development of new structural forms that are resilient and more resonant with the times.

2. THE IMPORTANCE OF ORGANISATION STRUCTURE

A number of writers have pointed out the importance of an organisation's structure and the relationship between it and an organisation's size, strategy, technology, environment and culture. Mintzberg (1989) has written extensively and significantly on the importance of organisational structure. Miller (1989) has explored the importance of configurations of strategy and structure. Burns and Stalker (1961) concluded that if an organisation is to achieve maximum performance then its structure must fit with or match the rate of change in its environments. Handy (1990, 1993) has discussed the importance of culture in relation to organisational design and structure and the need for new organisational forms. Pascale, Milleman and Gioja (2000, p.197) consider 'design is the invisible hand that brings organizations to life and life to organizations.' Further, organisational structure and design are closely entwined (Mabey, Salaman & Storey, 2001) with many aspects of human resource management. Thus structure has a key role in the all important human dimension of an organisation.

I would argue that if the structure of an organisation and the underlying design principles which construct it are not in tune with the core purposes of the organisation and its many environments then it is unlikely to successfully survive. For as Senge (1994) so succinctly points out, what use is the captain of the ship asking his crew to turn to starboard 60 degrees, if the rudder will only turn to port, or the ship takes six hours to respond to the command?

Too often the importance of organisation structure is overlooked and Miller (1989) points to a gap in the literature whereby the content of corporate or business strategies has not been widely considered in relation to structure. One of the most important aspects of a manager's role is the design of organisational structures, yet this is often a neglected responsibility (Senge, 1994). McMaster (1996) argues that organisational design is not well understood and traditional management education does not include the development of any understanding of the principles of corporate design. The impact of the floury of corporate restructures that took place in the 1980s and 1990s, discussed later in this paper, supports this view. I would suggest that this lack of genuine understanding is a serious shortcoming.

3. DEFINITIONS OF STRUCTURE

Mullins (1993) and Mabey, Salaman & Storey (2001) describe the structure of an organisation as the pattern of relationships between roles in an organisation and its different parts. They see the purpose of this structure as serving to allocate work and responsibilities in order to direct activities and achieve the organisation's goals. Structure enables managers to plan, direct, organise and control the activities of the organisation (Mullins, 1993, Mabey, Salaman & Storey, 2001). Here is a traditional view of organisational design that uses principles derived from classical and scientific management.

A non traditional approach is taken by Pascale, Milleman and Gioja (2000, p.197). They consider the role of architects and the principles they use to create buildings that provide '(1) structural integrity (sound buildings), (2) functionality (space appropriate for its intended use), and (3) aesthetic appeal.' Using these principles an architect is able to work with the client in order to create a structure that is an integral and facilitating aspect of the life of the people who move in and around it. Thus architectural approaches can offer us a good model with which to consider organisation design principles.

I would define an organisation's structure as the architecture both visible and invisible which connects and weaves together all aspects of an organisation's activities so that it functions as a complete dynamic entity. One simple approach is to consider how an organisation's structure is described when represented diagrammatically, which is most often shown in the organisation chart. This provides useful insights into the underlying design principles. It will not show informal structures, but this is not the focus of this paper, except where they are an integral part of the design, as in for example, design principles derived from complexity.

4. EARLY ORGANISATIONAL FORMS & THE INFLUENCE OF CLASSICAL SCIENCE

As Handy (1993, p.350) points out, it is a long held assumption that organisations need a hierarchical command structure if they are to work. But, he writes:

'there is no logic which says that this horizontal decision sequence needs to be turned into a vertical ladder so that those who take the necessary earlier decisions are higher in the hierarchy than those who implement them. That is where history comes in, for those who got there first obviously set things up this way.'

So who got there first? Until the spread of the Industrial Revolution in the 18th and 19th centuries most people were occupied in some kind of agrarian activity and most were

self-employed. Large organisations, apart from the church, the state and the army, were virtually unknown. Thus when early entrepreneurs first set up their enterprises they followed the hierarchical, command and control structure models of these older organisations. They believed that centralised production with division of labour offered more control over their workers, and enabled them to promote improvements in production methods (Salaman, 2001). This approach was reinforced by a capitalist profit driven theory of organisation design and the development of the capitalist system made a major contribution to the development of early organisational forms (Salaman, 2001).

The development of new technologies and new machinery for production further influenced the design of early businesses and the way they were expected to function. It was a time when non material structures were not considered important (McMaster, 1996). The machines were all important and most workers became machine operators or hands and individual skills and traditional ways of working were replaced and lost.

Another important factor in the design of early industrial organisations was the predominant classical scientific view of the world. The work of Copernicus, Galileo, Newton and Descartes led to a view of the world as a giant clockwork machine operated by a series of predictable universal laws. It extolled the virtues of the intellect, logic and reason, over intuition and the senses, and advocated an analytical, empirical, reductionist approach to understanding the world. This powerful paradigm encouraged the development of linear structures and reductionist thinking. It underlined the importance of the division of labour and encouraged an organisation structure made up of layers of separate neat compartments. It was a way of thinking reflected in the physical architecture of the early textile mills which rose up floor upon floor, with the machinery laid out in both horizontal and vertical linearity.

Further, classical science called for the separation of the head or the intellect from the hand or the senses and this led to the emergence of white collar workers and blue collar workers and their separate cultures. These distinctions are ingrained in our working culture and their roots spring from the patterns of work evolved during the industrial revolution (Fowler, 1997). Thus in the 18th and early 19th centuries the design model of a factory organisation emerged. It was one based on division and control and heavily influenced by the Newtonian-Cartesian paradigm.

Near the end of the 19th century management began to emerge as a prime and necessary function for the effective factory (Salaman, 2001). The end of the old sub contracting way of employing workers was replaced by direct employment, so the number of managers needed to carry out this role increased, as did technical and other administrative managers (Salaman). Thus the emergence of the different functions as essential features of organisational forms.

5. THE 20TH CENTURY – A PERIOD OF TRADITIONAL EXPERIMENTATION?

Henri Fayol is credited by many as being the founder of modern management theory and practice. Writing at the beginning of the 20th century he advocated an organisation structure that was centralised, functionally specialised and hierarchical, in which everything had its specific place. Management was viewed as being all about planning, organising, forecasting, co-ordinating and controlling. Others built on Fayol's work,

which Morgan (1986) claims provided the foundation of management theory in the first half of the last century, and which is still much in use up to the present day.

Also in the early 20th century Frederick Taylor drawing on his understanding of traditional science and scientific method devised a theory of management - scientific management. He advocated the use of 'scientific' methods of measurement and analysis and broke all tasks down into small repetitive components. This was considered the most effective way of operating a production process and his methods achieved their apogee in the Ford motor car production line process.

Thus the basic structure of many large organisations in the 20th century was founded on linear, segmented, hierarchical design principles as typified by Figure 1. The larger the organisation the larger the structure and the more sub divisions. It was an approach to organisation design that reflected the classical scientific worldview as did the early management theorists.

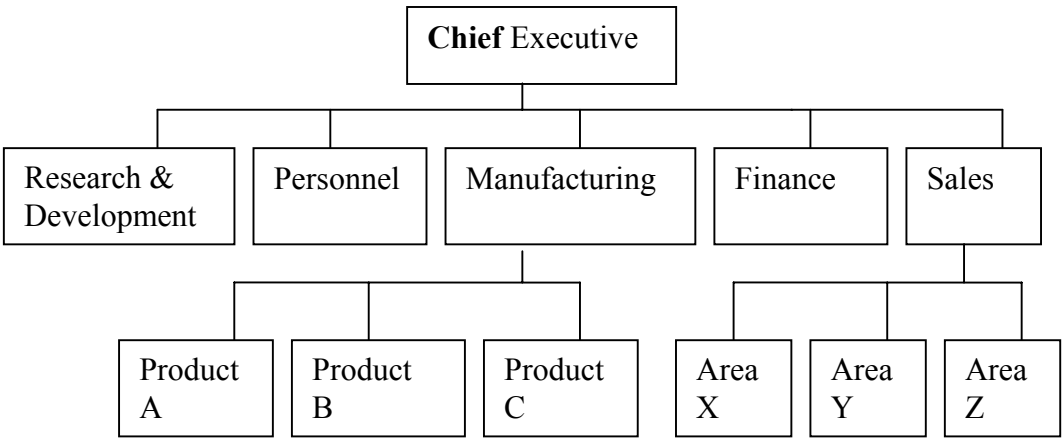

Figure 1. Traditional Organisation Chart / Structure (adapted from Weinshall, 1971, in Handy, 1993 p.257)

During the mid 20th century there was a trend for organisations to create huge corporate structures, often composed of many varied and different businesses, for example, the Hanson Trust, Trafalgar House, Unilever, and GKN in the UK and General Electric in the USA (Mabey, Salaman & Storey, 2001). In the public sector too, huge bureaucracies were created with the nationalisation of the public utilities after World War II and the creation of the NHS in 1948. The management of these huge organisations required a complex multilayered structure with many sub divisions. Mabey, Salaman & Storey (2001, p.157) write:

> *'Tall structures were created with as many as 20 plus levels between the chief executive and the shopfloor operative. Managerial control of employees at all the multiple levels was based on a mixture of direct command and budgetary responsibility. Hierarchy, command and control were the governing principles of employee management.'*

But by the last decades of the 20th century, however, the trend for larger and larger structures was over. Almost every organisation experimented with some kind of structural change process (Ashkenas et al, 1995). Large conglomerates were broken up

and large bureaucracies slimmed down as organisations sought to become more effective and flexible (Mabey, Salaman & Storey, 2001). Companies merged and demerged, made acquisitions or sold them off and experimented with a range of approaches designed to make them more effective and responsive to a rapidly changing world. During this period organisations were awash with notions of delayering, right / down sizing and business process re-engineering and for a time returns to shareholders were at record levels (Willis, 2001).

Downsizing was used by many companies as a way of adjusting their structures in order to be fitter and more effective. Large organisations with many bureaucratic aspects like Kodak, IBM and General Motors restructured in this way (Mabey, Salaman & Storey, 2001). This and the often accompanying trend for outsourcing resulted in a wave of new problems particularly with employee insecurity and loss of expert knowledge. Coulson-Thomas and Coe (1991) report that in many of these slimmer organisations there were issues of work overload, increased work stress, lack of vision, poor decision making, corporate in fighting and so on.

Further, this approach proved to be an unsatisfactory one, not only because of the immediate social costs and the loss of experience and valuable skills, but because many organisations failed to capitalise on the restructuring and implement new supportive systems (Mabey, Salaman & Storey, 2001). They changed the structure of the organisation but not in such a way as to improve its overall long term effectiveness. This apparent lack of insight concerning the importance of the relationship between structure and internal and external systems and human behaviours displays a restricted understanding of the principles of organisation design.

Business process re-engineering was another approach which many adopted during this period as an effective way of improving efficiency and removing bureaucratic structures. But, Mumford and Hendricks (1996) point out, many companies became obsessed with cost cutting and associated staffing reductions and did not consider how best to reorganise and restructure. Also some chief executives used the process to rid themselves of cumbersome bureaucratic chains of command but failed to cede control (Mumford and Hendricks, 1996).

Mabey, Salaman & Storey (2001, p.158) describe this period as one of 'apparent chaos' as organisations also tried out approaches based on networking, outsourcing and notions of virtual forms of organisation. However, they provide an analytical framework which I shall use to describe the different types of structure that still predominate. It offers four main types of structure: bureaucracy, divisionalised structures, strategic business units and 'de-structured' forms.

5.1 The Bureaucracy

Classical bureaucracies are structured on principles of hierarchy, authority and notions of control and they consider the use of rational approaches and long term planning processes as highly desirable. They are neatly structured into many compartmentalised layers in a reductionist approach to design. Most organisations have some bureaucratic aspects to them such is the power of the mechanistic concept (Morgan, 1986). Mabey, Salaman & Storey (2001) also point out that in spite of delayering, more flexible job design, team working across functions and a range of reshaping change initiatives most large organisations today are essentially still bureaucracies.

5.2 Divisionalised Structures and Strategic Business Units

The 1980s and 90s also saw decentralising as a key trend for many large organisations who set up divisionalised structures and strategic business units. Corporate roles and responsibilities were devolved out to the individual divisions or units, with strategic business units having more autonomy and less centralised features than divisional structures. As a result of these approaches many of the synergies and advantages of a large company were lost and the new structures often failed to build in strong links across units so that core competencies were shared and corporate cohesion maintained (Mabey, Salaman & Storey, 2001). Decentralisation appears to be a continuing process but as Mabey, Salaman & Storey (2001, p.158) observe, a process which appears to be made possible 'by a series of moves which amount to increased centralisation'.

5.3 'De-structured' Forms

Mabey, Salaman & Storey (2001, p.164) use this definition to cover a wide range of organisation structures 'variously described as high performance organisations, knowledge creating companies, empowered teams, ad hoc, boundaryless, and process-based'. There is a strong similarity about these organisations in that they have endeavoured to break free from the traditional bureaucratic form. Mabey, Salaman & Storey (2001, p.164) write:

> *'the new watchwords are teams (preferably cross-functional), lateral communications, the minimization (if not outright removal) of hierarchy, and the sparse use of rules. Informality and the exploitation of expertise, wherever it may lie in the corporation, are the essential idea. With some variance in emphasis, the same basic tenets can be found underpinning the so-called "high performance work systems" and the "knowledge creating companies".'*

6. ORGANISATIONAL FORMS FOR THE 21ST CENTURY

At the end of the 20th century some less traditional forms of organisation structure began to emerge as evidenced by the 'de-structured' forms described by Mabey, Salaman & Storey (2001). Handy (1990) observes that the old mechanistic systems are everywhere breaking down. Mabey, Salaman & Storey (2001) talk of the emergence of a new paradigm for organisational form which seeks to replace the rigidity and cumbersome nature of the traditional form. Ashkenas et al (1995) report on a change in design principles that amounts to a major shift. Figure 2 summarises the success factors of both the 'old' and 'newer' approaches as described by Ashkenas et al (1995, p.7)

OLD SUCCESS FACTORS	NEW SUCCESS FACTORS
size	speed
role clarity	flexibility
specialisation	integration
control	innovation

Figure 2. Design Principles for Organisation Success (from Ashkenas et al, 1995)

The shift in design principles recognises that size (large), role clarity (compartmentalisation and levels of authority), specialisation (subdivisions of role / tasks and tight functionalism) and control, all typical of the traditional type of organisation structure shown in Figure 1 are no longer effective. From a complexity paradigm perspective the shift is encouraging and the new success factors resonate well with complexity principles. But is this shift in design principles truly a deep level, second

order change or transformation (Dale, 1994) where mental models have shifted? Or is it a superficial change (Morgan, 1993) that has arisen as a learning response to past weaknesses and where nothing of real significance has happened? I would suggest that for most large organisations it is probably the latter. They have amended or adjusted their design principles but have not thought about organisation design in a ground breaking way that is truly innovative.

One innovative approach to organisational form that has emerged is an organisation with a structure built upon a foundation composed of purpose and core values (Senge, 1994). Senge illustrates this with reference to Johnson and Johnson in 1982 when their clear sense of purpose effectively guided them through a major crisis that threatened its survival. Another good example of this kind of organisation is St Lukes the award winning advertising and communications company which has built itself on 'invisible' structures: values and moral principles (Lewin and Regine, 1999). This is an approach that resonates well with complexity science principles, especially self organisation.

St Lukes also deliberately eschewed the traditional linear organisational form and has a form based on a 'Citizen Cell Structure' (Law, 1998). See Figure 3. Each cell is a self managed group of 35 people that is able to develop in its own way rather like a micro culture which mirrors the overall culture of the company. The cells keep in touch and in harmony with each other and the overall philosophy of the company by a range of shared weekly, monthly and annual events. If the cell grows successfully then it splits and forms two new cells. Each new cell then is responsible for its new growth and development.

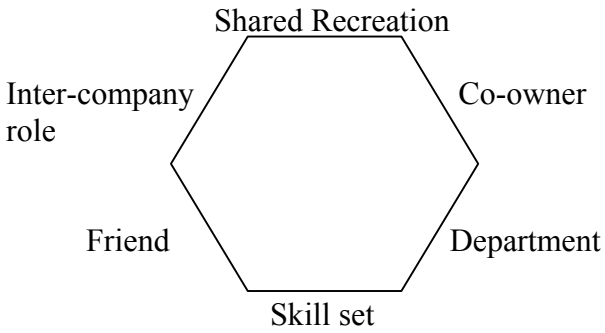

Figure 3. Different Facets of the Citizen Cell (adapted from Law 1998, p.127)

The founders of St Lukes were not aware of complexity science at the time they built up their business, but they were doing what complexity would advise when seeking a major change (Lewin and Regine, 1999). Further, the structure of the organisation supports its dynamic, interactive, team working approach which is 'a perfect example of a complex adaptive system operating in the creative zone' (Lewin and Regine, 1999, p.105). Another organisation that has used complexity principles is Sencorp, USA which has used a fractal management model to inform its structure (Slocum and Frondorf, 2000). This, Slocum and Frondorf report, has resulted in a more knowledgeable workforce and improved decision making.

7. DESIGN PRINCIPLES DERIVED FROM THE COMPLEXITY PARADIGM

There are few organisations like St Lukes and Sencorp that have drawn on principles from complexity science to create radically new forms. So how do design principles

derived from the classical scientific paradigm differ from those derived from a complexity science paradigm? Figure 4 shows a table of possible comparisons.

'Classical Science' Model	**Complexity Science Model**
Linear	Non linear
Hierarchical	Non hierarchical
Reductionist	Holistic
Controlling	Self Organising
Inflexible	Flexible
Uniform	Diverse
Centralised	Networked

Figure 4. Organisation Structure and Design Principles: A Comparison.

If we compare the complexity science model above with the new success factors in Figure 2 taken from Ashkenas et al (1995) then the only listed common attribute is 'flexible/flexibility'. I would suggest that the principles derived from complexity directly tackle the structural architectural and behavioural problems recognised, but perhaps not addressed, in Figure 2. For example, if a non linear approach is taken to organisational design then it would be extremely difficult to construct a tall, multi-layered structure with all the attendant bureaucratic complexities. Also it would support the attainment of non-hierarchical principles and other inter related key aspects of a complexity style organisation plus the attainment of the new success factors shown in Figure 2.

If we look more closely at complexity what key aspects could help realise the complexity science features in Figure 4 and underpin an organisational structure derived from a complexity paradigm perspective? Further, how might such a model structure appear and how might it work? In order to attempt to answer these questions I intend to consider the following 4 key features of complexity science: self organising principles; complex adaptive systems; fractals; notions of patterning, flow and rhythm, and design a speculative structural model.

7.1 Self Organising Principles

Self organising systems are sometimes known as self renewing systems as they dissipate their energy in order to renew themselves and Prigogine's work on dissipative structures is central to understanding the development of these systems (Wheatley, 1994, Capra, 1996). Self organising systems need energy to ensure their renewal (Wheatley, 1994) and intrinsic to this is their openness. The system has to be open to its environment so that matter and energy can be continually exchanged Capra (1996). Capra (1996, p.85) writes:

> *'Summarising… we can say that self-organization is the spontaneous emergence of new structures and new forms of behaviour in open systems far from equilibrium. Characterised by internal feedback loops and described mathematically by nonlinear equations.'*

Spontaneity is also a key feature of these systems as they interact and reshape themselves (Waldrop, 1994, Wheatley, 1994, Kauffman, 1996).

7.2 Complex Adaptive Systems

Complex adaptive systems are made up of large numbers of agents who interact with each other in a non linear way, creating higher and higher levels of complexity. There is no central controlling mechanism and any coherent behaviour in the system arises from co-operation and competition between the different agents themselves (Waldrop, 1994). They have self organising attributes but they differ from self organising systems in that learning to adapt to changing circumstances is a key feature. Further, complex adaptive systems do not respond passively to events but rather they actively try to turn whatever happens to their own advantage (Waldrop, 1994). Waldrop refers to John Holland who describes how complex adaptive systems not only are able to constantly revise and change their structures as they learn about the world but they are also able to anticipate the future.

7.3 Fractals.

The term 'fractal' was coined by Benoit Mandelbrot to describe a new type of qualitative geometry whereby irregular shapes repeat themselves up and down the scales of length (Coveney and Highfield, 1995). Fractal shapes are ubiquitous in nature and form the basic design principles of many natural structures.

7.4 Flows, Patterns, Rhythms

Flow, pattern and rhythm are important features of many aspects of complexity. A self organising system has a rich mix of positive and negative feedbacks which create their own patterns (Wheatley, 1994) and one cannot appreciate the phenomenon of self organisation without understanding pattern (Capra, 1996). Fractals form repeating patterns on differing scales. Lewin (1993) refers to a conversation with Murray Gell-Mann who considers that complex adaptive systems seek for patterns as they interact and learn from their environment. Pattern recognition is a key way of recognising, learning and understanding things that is used by the human brain, itself a complex adaptive system. Gleick (1993) refers to Libchaber and his development of the concept of flow. Flow is shape plus change, motion with form. Flow is universal, it may be applied to notions of history or economics. It may be laminar, or bifurcating or oscillating or even chaotic (Gleick, 1993). It is a dynamic notion with many applications. Rhythm and rhythmic cycles are essential features of the natural world (Stewart, 1997) and closely intertwined with notions of patterning and flow.

7.5 Speculative Model: A Fractal Web

The model was devised by thinking about biological structures and the human circulatory system and its fractal dimensions in particular. The model has non linear interconnectedness; is designed to allow a constant flow of energy and matter (information) throughout its whole; and via its 'arteries' is open to its environments, all characteristics of a self organising system as described by Capra (1996). The structure allows for employees to respond spontaneously to events guided by an overall sense of direction and purpose - key attributes of self organisation (Morgan, 1993, McMillan, 2000). Groups of employees are able to form into project teams in response to information and ideas flowing through the system in a way that fits well with Stacey's (1996, p.333) description of self organisation as:

> *'the spontaneous formation of interest groups and coalitions around specific issues, communication about those issues, co-operation and the formation of consensus on and commitment to those issues'.*

If an organisation is to encourage and support self organisation and self organising project teams then it needs to provide the right kind of environment underpinned by a supportive organisational ethos and set of values (McMillan, 2000). Thus the importance of the 5 inner 'chambers' of the fractal web and the Ethos and Values artery and the Purpose/s artery. This is the heart of the web which nourishes the whole organisation and ensures that everyone shapes, shares and understands the driving principles of the organisation. According to McMaster (1996) a rich variety of forms is possible by using values or operating principles as simple set of rules or attractors.

The structure is designed to ensure that it develops as a *genuine* complex adaptive system by recognising learning and experimentation needs and the key role they play in facilitating dynamic adaptability and spontaneous responsiveness to change. The underpinning design principles enable the organisation to unfold or emerge as it learns and grows as a result of its own activities and its responses to the external environment (McMaster, 1996). Further, a structure with learning space for individuals to experiment, change and adapt co-operatively will enhance organisational sustainability (Allen, 2001).

Fractal geometry and patterning are key underpinning design principles in that the simple web pattern formed by the circular arteries and the east / west arteries can be replicated on different scales. The pattern within the inner Purposes artery is repeated on a larger scale within the Ethos and Values artery and again on a larger scale within the Intelligence artery. Further, the model replicates the aspects and form of groups within the structure and also individuals. Every level is imbued with the ethos and values of the organisation. All participate in learning; speculate on the future; take risks with ideas and experimentation; work on projects; consider external aspects; share and value experience/s and knowledge; draw on resources; observe safety and legal requirements; embrace customers, and chill out and relax from time to time. However, you slice the structure it is a fractal one.

Figure 5 shows the organisation with all the necessary arteries and spaces or chambers needed to function effectively, but if the organisation grows it may add more arteries or extend existing ones and create more spaces – whatever is needed.

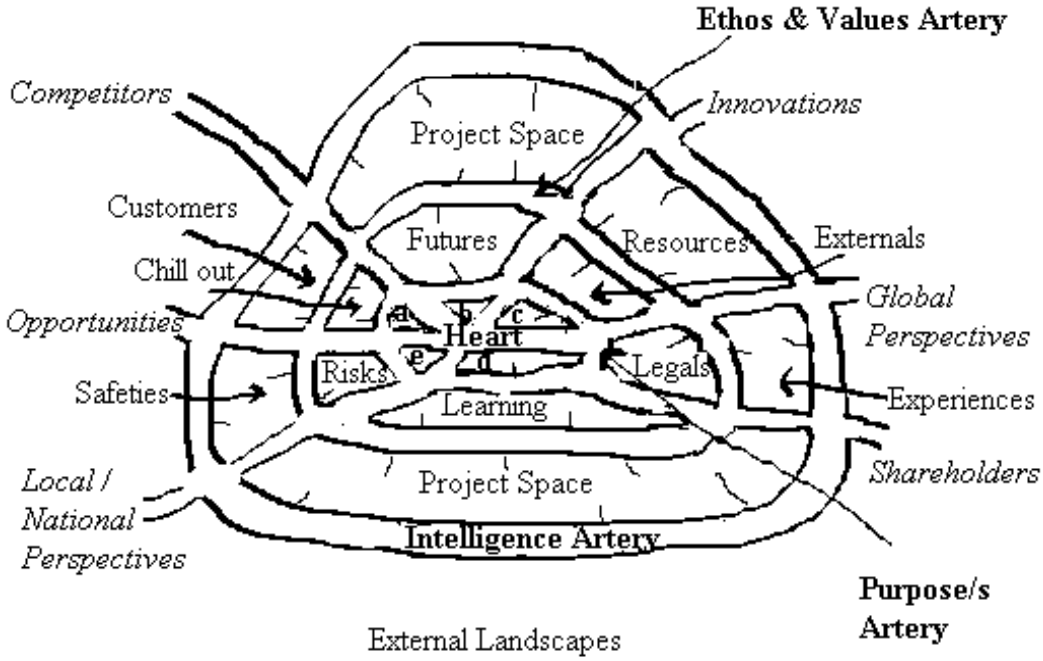

Figure 5. Fractal Web

The Chill out space recognises how human energy rhythms can fluctuate, and how sometimes there is a need to slow down, or pull out temporarily, and reflect on events. The design principles also include the notion of continuous flow as essential to nourish the organisation. Information and ideas flow throughout in waves of changing depth and speed as they respond rhythmically to the external landscapes and internal responses. If, for example, the Global Perspectives artery and the Opportunities artery both feed in important and exciting information that the Futures space responds to enthusiastically then a powerful flow would unfold throughout the structure.

Each space or chamber in the model is dynamic and not fixed. Thus they may change shape in response to the individual/group/organisation's needs, as may the number of different types of space. The size of the space or number of spaces devoted to a particular 'theme' indicates the number of people and resources involved and the amount of activity. As spaces expand so others will need to contract or alternatively the organisation would need to extend its overall boundaries. It is able to do this, as already described, without dismantling or breaking up the overall structure or compromising its design principles. It is a structure that is flexible and responsive to the needs of the organisation with changeability built into the design. In other words, its shape is able to ebb and flow as it renews itself.

The arteries ensure that intelligence and energy from inside and outside the organisation is pumped around the structure. This is essential for learning to take place and for knowledge to develop. The small 'vessels' like blood vessels in a human system carry 'nutrition' (rich and diverse information) from the different spaces around the organisation ensuring that this flows into the large arteries and throughout the structure ensuring that everywhere is constantly nourished. Feedback becomes 'feedaround'. The larger the space the more small vessels are connected to it to ensure that organisational flow continues. If two small vessels join then a new small artery is formed. It is a very

co-operative system with considerable positive feedback and high synergy and this will support organisational sustainability (Allen, 2001). The structure enables the organisation to operate like a complex adaptive system by supporting learning and adaption and by enabling itself to constantly revise its shape in response to learning from events and intelligence gathered.

The 'heart' area is where all the arteries meet and are encircled by the Purpose/s artery. This is the core or confluence of the organisation – where all the arterial flows mix and meet. This creates a rich mixture which circulates through all the system influencing and guiding in symbiosis with other 'cells' of information or intelligence as they feed in. The inner chambers marked a, b, c, and d represent the core or essential principles of the organisation. In the Open University these chambers would include openness and openness to people, to places, to methods and to ideas. These principles contribute to the confluence of flows and enrich the 'blood' moving around the organisation energising activities and giving focus and clarity to direction and decision making. It is an organisation's capacity to generate an ongoing flow of new knowledge that will ensure its survival (Allen, 2001).

The model shows the west/east arteries collecting intelligence from the external environment. The external sources, indicated in italics, will vary for individual organisations, as will the number and size of the project spaces. All the other features are considered essential. For example, any organisation must consider legal and safety issues and responsibilities and needs a range of resources whether human, financial or material to draw upon.

Everyone in the organisation moves around and spends time in different spaces, and several spaces at one time too, even if they are specialists. An accountant, for example, will always spend a percentage of his/her time in the Resources space but they will also be active in other spaces too. Specialists also include those who have a major responsibility for ensuring that 'nutrition' flows through a particular artery and the spaces adjacent to it. Thus making sure that intelligence is exchanged and fedaround the whole organisation. This specialist role will not be permanent as taking on different roles will facilitate connectivity, encourage learning and a deep understanding of how the organisation works as a whole. Leadership will be distributed throughout, however, individual leaders or groups of leaders may emerge on a temporary basis in response to specific issues or organisational needs. So for example, if there is a major cash flow crisis then a group of informed and interested people (including financial specialists) will take the lead in searching for a solution, and will continue to lead until the crisis is resolved.

The model is a first prototype and as Allen (2001) points out it is impossible to predict the success of a particular design and wide explorations are necessary as part of the design and innovation process. I would therefore, welcome comments and observations in order to improve the model. The possibility of a real world trial would be especially welcomed.

8. CONCLUSION - NOTIONS OF STRUCTURE – TIME FOR A MAJOR RETHINK?

As I have described in this paper, the last decades of the 20th century saw widescale experimentation with organisation structure. Most organisations achieved only limited success and many restructures involved considerable social costs and limited gains in

effectiveness. There is considerable evidence to suggest that the design principles upon which most modern organisations are structured continue to be based on traditional notions of bureaucracy and hierarchy (McMaster, 1996, Mabey, Salaman & Storey, 2001) supported by linear and reductive thinking (Morgan, 1993). Thus, with few exceptions, the underlying design principles remain unchanged.

As McMaster (1996, p.59) points out our approach to organisation design is overshadowed by principles 'so old that we think the way we see things is the way they should be.' These principles are rooted in a predominantly Newtonian-Cartesian worldview, which as Winograd and Flores (1991, p.15) point out, has been 'the mainspring of Western science and technology' for centuries and is embodied in management science. Senge (1992) observes that people in the Western world think in linear ways and see the world from a linear perspective. This, he observes, poses real difficulties when people use thinking designed to solve simple static problems in a complex, dynamic, non linear world. This way of thinking and viewing the world hinders progress on understanding organisation design and in constructing design principles that are appropriate and effective for today's organisations.

To conclude, organisations and those leading them need to improve their understanding of the nature of organisational structure and the importance of underpinning design principles and the key role they play in improving organisational performance, enhancing sustainability prospects and satisfying the human dimension.

Further, I would suggest that the use of design principles derived from a thorough understanding of the complexity paradigm offer a way forward that will break effectively with past approaches that are no longer relevant, and in some cases positively damaging to organisations and individuals. The use of these principles will facilitate the development of new structural forms that are more resonant with the times and therefore designed to respond to conditions of rapid change and uncertainty.

REFERENCES

- Allen, P. M. (2001) 'A Complex Systems Approach to Learning in Adaptive Networks' *International Journal of Innovation Management*, Vol. 5, No.2. pp. 149 – 180.
- Ashkenas, R., Ulrich, D., Jick, T., and Kerr, S. (1995) *The Boundaryless Organization Breaking the chains of organizational structure*. San Francisco, Jossey-Bass.
- Burns, T. and Stalker, G. M. (1961) *The Management of Innovation*. Tavistock.
- Capra, F. (1996) *The Web of Life*. London, HarperCollins.
- Coulson-Thomas, C. and Coe, T. (1991) *The Flat Organisation: Philosophy and Practice*. British Institute of Management.
- Coveney, P. and Highfield, R. (1995) *Frontiers of Complexity*. New York, Fawcett Columbine.
- Dale, M. (1994) 'Learning Organizations' in Mabey, C. and Iles, P. eds. *Managing Learning*. Routledge in association with the Open University.
- Gleick, J. (1993) *Chaos*. London, Abacus.
- Handy, C. (1990) *The Age of Unreason*. London, Arrow Books Ltd.
- Handy, C. (1993) *Understanding Organizations*. 4th ed. London, Penguin Books.
- Kauffman, S. (1996) *At Home in the Universe: The Search for the Laws of Self Organization and Complexity*. London, Penguin Books.

- Law, A. (1998) *Open Minds*. London, Orion Business Books.
- Lewin, R. (1993) *Complexity. Life on the edge of chaos*. London, Phoenix.
- Lewin, R. and Regine, B. (1999) *The Soul at Work*. London, Orion Business Books.
- Mabey, C., Salaman, G., Storey, J. (2001) 'Organizational Structuring and Restructuring' in Salaman, G. ed. *Understanding Business Organisations.* London, Routledge.
- McMaster, M. D. (1996) *The Intelligence Advantage. Organizing for Complexity*. Newton, MA, Butterworth Heinemann.
- McMillan, E. (2000) 'Using Self Organising Principles to create effective project teams as part of an organisational change intervention: A case study of the Open University', in *Complexity and Complex Systems in Industry*, McCarthy, I. and Rakotobe-Joel, T. eds. University of Warwick, UK.
- Miller, D. (1989) 'Configurations of Strategy and Structure: towards a synthesis', in *Readings in Strategic Management*. Asch, D. and Bowman, C. eds. London, Macmillan Education.
- Mintzberg, H. (1989), 'The Structuring of Organizations', *Readings in Strategic Management*, Asch, D. and Bowman, C. eds. London, Macmillan Education.
- Morgan, G. (1986) *Images of Organization*. Sage.
- Morgan, G. (1993), *Imaginization.* Sage. Newbury Park, California.
- Mullins, L. J. (1993), *Management and Organizational Behaviour*, 3rd ed. London, PitmanPublishing.
- Mumford, E. and Hendricks, R. (1996) 'Business process re-engineering RIP', *Personnel Management*. Institute of Personnel and Development, May 1996.
- Pascale, R.T., Milleman, M., and Gioja, L. (2000) *Surfing the Edge of Chaos*. London Texere Publishing Ltd.
- Salaman, G. (2001), 'The Emergence of New Work Forms' in Salaman, G. ed. *Understanding Business Organisations.* London, Routledge.
- Senge, P. (1992) *The Fifth Discipline: the art and practice of the learning organization*. London, Century Business.
- Senge, P. (1994) 'The leader's new work' in Mabey, C. and Iles, P. eds. *Managing Learning*. London, Routledge.
- Slocum, K. R., and Frondorf, D. S. (2000)'Business Management using a Fractally-scaled Structure', *Complexity and Complex Systems in Industry*, McCarthy, I. and Rakotobe-Joel, T. eds. University of Warwick, UK.
- Stacey, R. D. (1996) *Strategic Management and Organisational Dynamics*. 2nd ed. London, Pitman Publishing.
- Stewart, I. (1997) *Nature's Numbers*. London, Phoenix, Orion Books.
- Waldrop, M. M. (1994) *Complexity*. New York, Penguin Books.
- Wheatley, M. (1994) *Leadership and the New Science.* San Francisco, Berrett-Koehler.
- Willis, R. (2001) Personal Communication.

Winograd, T. and Flores, F. (1991) *Understanding Computers and Cognition: a foundation for design*. Reading MA, Addison-Wesley.