From Systems Boundaries to Fractality: Broadening the Practitioner's Paradigm

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ABSTRACT: *Boundary setting has proven problematic for systems practitioners when applying their discipline across the breadth of complex social systems. The rise of complexity theory, especially when applied to such complex social situations, brings with it the notion of fractality as a means of identifying a manageable construct of that complexity, much as systems theory does through setting boundaries. Each approach has its merits, with this paper suggesting greater relevance of systems practice in situations closer to states of equilibrium and greater relevance of complexity practice in complex social situations closer to the edge of chaos.*

Keywords: Systems Theory, Complexity Theory, Boundary Critique, Fractality, Equilibrium, Edge of Chaos.

INTRODUCTION

Systems boundaries and complexity's fractals share the common factor of defining discrete entities that can be grasped by the human mind in a manageable way. Soft Systems Theory and Complexity Theory have much in common. Both theories recognise a dynamic, self-organising, adaptive and often unpredictable world. Both are contextually relativist: the notions of embedded systems and fractals (from Complexity Theory) are but useful constructions of reality, rather than descriptions of reality itself.

Both seek to honour and give expression to the diversity of perspectives offered by those within the system or fractal level, and both seek to generate new understanding from the perspectives of stakeholders.

Following three decades of systems practice, it is becoming apparent where the strengths of its theory lies. It is proposed that this strength is in social situations close to equilibrium. Away from equilibrium and closer to the edge of chaos, Complexity Theory begins to assert more relevance.

A 'SYSTEMS' WORLD

The importance of boundaries stems from the purpose of systems practice and the assumptions upon which it is based. For most soft systems practitioners, the paramount goal of building understanding is improvement of the system. To achieve this, it is necessary to analyse the system's purpose, its environment, its sub-systems, its inputs and outputs, any feedback loops which it exhibits, hierarchies which might be discerned and to be watchful for unexpected, emergent properties of the system.

This analysis is carried out to gain an understanding of the system so that the practitioner/stakeholder group can decide the best course of action to make a positive difference – an improvement – to the system. It is assumed that by intervening strategically in the feedback mechanisms and other aspects of the systems, the practitioner can influence, control and direct the system into directions agreed upon – by stakeholders – as an improvement.

The 'agreed upon' intervention is arrived at through a synthesis of the above analyses, informed by appropriate theory and the application of a particular logic. Stakeholders are then in a position to name the desired change and manage or control movement towards it.

From a systems perspective, one can generate, in company with affected stakeholders, a sufficiently informed understanding of the qualities of, and the relationships between, the system, sub-systems and supra-systems in order to know what would constitute an improvement to it. The validity of such an understanding, however, is premised on the dynamics of the situation: the closer the situation is to a state of equilibrium, the more likely the analysis will hold true for a longer period in which an improvement can be pursued; the closer the situation is to the edge of chaos – where unpredictable changes occur spontaneously – the less likely the initial analysis will hold true, leading to redundancy in the improvement to be imposed.

A 'COMPLEX' WORLD

Complexity theorists assume the universe is more dynamic and less predictable than we would like to believe, that it is self-organising and adaptive, that it is evolving into an even more complex universe and that no single purpose can be identified as its *raison d'être*. Complexity theorists seek increased understanding in order to participate personally, critically and meaningfully, in such a 'complex' world. Participation is based less on the need for understanding for improvement, intervention and control, and more on understanding for enlightenment – critical and epistemic awareness – leading to increased choices for future, personally meaningful action in an ever-changing world.

While fractality came to us from the mathematician Mandelbrot in the 1970s, the concept can be usefully applied to social systems. An individual human, for instance, is a dynamic, organic entity. Similarly, a family can be seen as a dynamic, organic entity, as can a region's population, a state's population, a nation's population and the global population. Although each of us is a distinct and unique individual, we simultaneously belong to a distinct and unique family, a distinct and unique regional population, and so on through larger and larger scales of identification.

Fractality allows us to see the universe in a new way. It is an holistic as opposed to a reductionist theory, enabling us to see our lives as complex, natural phenomena, rather than a discontinuous set of circumstances, function and actions. It is a simultaneous unravelling and entanglement of the phenomena of life, work and society.

This paper works with the assumption that the concept of fractality resonates harmoniously with the complexity of human experience. Through fractality, one can simultaneously discern patterns and characteristics common at the individual level and global level and at all levels in between, be they familial, regional or national.

Simply put, a fractal is an entity with characteristics that are simultaneously apparent at many scales of focus. Looking at one fractal level enables the inquirer to make generalisations about other fractal levels at different scales. This has significant implications for overcoming boundary issues in systems thinking.

These fractal patterns can also be discerned in the non-human world of nature. For instance, the assumed arrangement of an atom's nucleus and orbiting electrons is similar to the arrangement of the earth and its orbiting moon, which is similar to the arrangement of the sun and its orbiting planets, which is similar to the arrangement of the centre of our Milky Way Galaxy and its orbiting plethora of stars, which is similar to the arrangement of the centre of our local cluster of galaxies and the orbit of the Milky Way, and its sister galaxies, around it…

From a complexity perspective, one can never know enough about the changeable, dynamic, complex and unpredictable world to be able to make even an informed judgement of what would 'improve' it. The best one can do is develop a critical understanding of the world, both as an individual and in company with others, and make choices about how to adjust one's actions to deal with it.

DETERMINISTIC AND ADAPTIVE FRAMES OF REFERENCE

An interesting difference between the above two examples of fractality can be identified: that involving atoms and galaxies tends to be deterministic in nature (self-organising on a time scale so vast that it appears predictable), while that of humanity tends to be adaptive in nature (self-organising before one's eyes). This has significant importance in relation to the choices made by systems practitioners and complexity practitioners.

Stacey (1996) notes that the laws of natural science are deterministic, whereas social practices are 'agreed upon' by people, either consciously or not, and are modifiable over time; they are adaptive.

To be able to bring about improvement to a system, systems practitioners work with it as if it were deterministic in nature: that it will continue behaving in the way that it has during the analysis phase of the intervention – and this has proven an effective strategy in the shorter term. This allows them to make predictions about the system's short-term future and how adjustment, here and there, can move the system into a more desirable future. Improvement comes to be defined from this deterministic, definitive stance.

Complexity practitioners hesitate to give a dynamic, human world such predictability. A complexity perspective is more useful over the longer-term, during which time the dynamics of the world have transformed it in perhaps unpredictable ways. Complexity practitioners work with the world as if it were adaptive in nature: that a 'snapshot' of the world today is likely to be entirely different to a 'snapshot' of the world tomorrow, and even unrecognisable in a 'snapshot' of it after a week or year. In the face of such uncertainty, complexity practitioners seek not to 'improve' the world of which they are a part, rather, they seek to generate critical awareness and a personally meaningful understanding of the flows of the dynamics in their world(s) and to work with them.

THE CHARACTERISTICS AND IMPORTANCE OF BOUNDARIES

A boundary marks what is included and what is excluded. Use of boundaries in defining systems – even if only a mental construct – determines what is included and what is excluded. Imposing boundaries around systems, sub-systems and supra-systems locks the mental construct to a single scale of focus.

Fractals require mental gymnastics: calling on the inquirer to recognise many scales of focus simultaneously – the local, regional, state, national, global and perhaps universal; the individual, family, community, nation and humanity. Because fractals are recurring patterns at various scales of focus, the characteristics recognisable at one fractal level are recognisable at all fractal levels. Fractals are, then, inclusive by nature. This has ethical ramifications, which will be discussed later in this paper.

Boundary setting has been used as a most useful tool in systems practice. It has become the way of bringing the unfathomable within the range of human understanding. On the other hand, fractality – a complexity concept – can be applied as an alternative to identifying systems and applying boundaries, especially in those situations closer to the edge of chaos than to equilibrium.

Boundaries have, for a long time, been a matter of importance and interest to systems thinkers. Churchman (1979), Ulrich (1983), Midgley (1997 and 1998) and Flood (1999) suggest systems boundaries are important for several reasons:

- To define the area about which critique is offered.
- To provide a finite context to determine what constitutes an improvement.
- To balance the number of stakeholders involved in the intervention, critique and decision-making against ethical considerations and concerns about power relationships.

One of the forgotten aspects of boundary judgements is that, at the time of planning and design, stakeholders make explicit their assumptions about the system and its environments; at the time of intervention – and particularly when improvements and outcomes are being actively sought – the tentativeness and fragility inherent in the assumptions are overlooked, and the resultant 'improvements' are considered with temporal certainty. This certainty would not seem appropriate, given the earlier tentativeness. Non-linear dynamics – which characterise so many social systems – require a more careful examination of both the theoretical and meta-theoretical underpinnings and their implications, not only before but also after the analysis of the system under consideration.

FACTORS IN BOUNDARY PLACEMENT

Commentators on the boundary issue in soft systems thinking note several areas that dictate the critical placement of a system's boundary. These concern:

- Defining the context of any critique.
- Limits on the number of stakeholders who can be involved.
- Emancipation: to promote the interests of all affected.
- Ethical and value judgements.
- The issues and dilemmas of concern and the nature of their improvement.

The Context Of Critique

In commenting on the notion of defining the context of critique, Ulrich (1983) and Midgley (1997) agree that boundaries have to be established within which critique can be conducted. Flood (1999) restates Churchman's perspective that "critique helps us to become more aware of the boundaries within which we live and operate… Critique, in everyday situations, involves listening to and responding to the viewpoints of one's worst enemies in reason" (1999, p.93). He writes that 'enemies' are they who are most likely to help their intellectual adversaries see the partiality and irrationality of their favoured boundary judgement and consequences relating to this.

Taking the stance of the 'enemy', then, it is drawn to the attention of systems practitioners that the context of a critique is not defined by the boundary of the system that constitutes the subject of the inquiry but by the boundary of the disciplinary or theoretical stance through which meaning and interpretation is being made of that system. A movie critic's response to a film depends not on the sequence of the scenes but on his or her mindset and worldview from which interpretation of those scenes is being made at the time.

It is proposed that a more useful context of critique could be developed by making explicit – and therefore building greater consciousness – of the influence of one's paradigm, the methods used, the values subscribed to by the stakeholder, and the assumptions each is making, at the levels of cognition, meta-cognition and epistemic-cognition (Kitchener 1983, Salner 1986). Making this context explicit gives other stakeholders and participants an informed understanding, rather than a speculative one, of why one inquirer describes the system (the subject of the inquiry) in a particular way. Through conversation, these individual understandings can be shared to enrich the critical stance of all stakeholders.

Midgley (1997) raises a concern about the discipline of Critical Systems Heuristics in that it does not allow for analyses of 'false consciousness' (p.42). Can any level of consciousness really be described as 'false'? It would seem 'true' enough to the individual holding it, so a better term might be 'limited' consciousness. We work with the assumption that consciousness is always limited because of its social embeddedness. These limits can be countered, but never eliminated, by critical awareness at all levels of cognition. It could, therefore, be argued that the frame of reference of the systems practitioner and, for that matter, the complexity practitioner, would be enhanced by the inclusion of learning theory, cognitive psychology and axiology.

Whether a systems practitioner or a complexity practitioner, the context of critique from either will be dictated by his or her methods, paradigm, values and assumptions, and his or her critical awareness at the cognitive, meta-cognitive and epistemic-cognitive levels. Development of finesse in articulating one's stance of critique would benefit both systems and complexity practitioners.

Limits on the Number of Stakeholders

Systems boundaries determine who is 'in' and who is 'out'. Those affected the most are most 'in', those less affected are marginally 'in' and those supposedly not affected are 'out'. Midgley, Munlo and Brown (1998) recognise that "researchers should remain aware of the need to access a diverse variety of stakeholder views in defining problems, and to 'sweep in' relevant information," but also that "sweeping in relevant information cannot be an infinite process" (p.1). Midgley (1997) also raises Ulrich's concern that "defining who is involved or affected comes about through making critical boundary judgements" (p.40).

This holds while the systems practitioner works with the assumption that he or she is working to reach a well-informed consensus, or majority view, of what constitutes an improvement and lines of action to achieve it. This contrasts with the complexity practitioner's assumption that the best he or she can do is generate a critical and personally meaningful understanding of the patterns and processes of a complex world and make informed choices for personal action in a world in flux.

Midgley (1997) reiterates Ulrich's argument that there is a limit to the number of people who can practicably be involved in communication. The systems practitioner is then faced with the quandary of ensuring all affected stakeholders are represented in the inquiry, yet that this number is small enough to be manageable to work with.

Could it be that this quandary arises because, in identifying a system (and in placing its boundary), systems practice, in a sense, establishes a 'real' and single ontology, rather than 'relative' and multiple ontologies? In establishing the system, sub-systems and supra-system and their boundaries, the approach has inadvertently become reductionist by identifying 'parts' and modelled the multiple ontologies of stakeholders as a single one.

The complexity approach doesn't attempt to define 'problems' and find relevant information. It seeks to have participants build a critical, personally meaningful understanding of the subjective worlds they live in, sharing, yet maintaining, the diversity of their ontologies. Through fractality, one can simultaneously discern patterns and characteristics common at the individual level and global level and at all levels in between. Based on this assumption of fractality and our proposition that the concepts of humanity and fractality resonate harmoniously, it follows then that involvement of the individual, at one fractal level, mirrors involvement of the global at a higher fractal level. This concept is further elaborated in the paper, 'Making Sense of Social Complexity through Strange Attractors' (Dimitrov and Woog, 2000).

This works, provided the individual doesn't seek to 'improve' the world, because he or she knows sufficient about it, but rather seeks to engage with the world, critically and meaningfully, at the fractal level represented.

This leads into the notion of emancipation to promote the interests of all affected.

Emancipation

Midgley, Munlo and Brown (1998) note primary and secondary systems boundaries that define the sacred and the profane (what is valued and what is devalued). The values of those who are included within the primary boundary are considered 'sacred', while the values of those people who are marginalised between the primary and secondary boundary are considered 'profane'. The values of those excluded from the system altogether are not considered. In establishing improvement, from a systems perspective, this is determined and judged from the values of those within the primary boundary.

Midgley (1997, p.40) notes Ulrich's position that "research should explicitly consider how the situation being investigated touches all the people involved or affected (directly or indirectly) and should promote their interests."

But can it be said the effects of systemic improvement recognise and confine themselves within the virtual boundaries of the defined system, sub-systems and supra-system? Surely they go beyond these boundaries to affect others in the world. If these people lie beyond the systems' boundary, systems practitioners need to make pragmatic choices about just how many of them to take into consideration?

Fractality dissolves this quandary by recognising that the **whole** is the whole is the **whole**, simply at different scales of focus. The individual is the family, is the community, is the region, is the nation, is humanity. Fractality includes all, so questions of outcome always take into account how "I" as individual, how "I" as community, how "I" as nation and how "I" as humanity am/are affected.

A different form of emancipation of interest to complexity practitioners is that of freedom from the fetters of uncritical and ill-informed understanding and action in the world. All actions in the world are complex, therefore, linearly imprecise and, in conventional terms, 'sloppy'. Sloppiness is their strength, not their limitation.

Blind obedience to a ritual or tradition allows no opportunity for choosing to act differently. Cultivating awareness of a diversity of perspectives and of the theories which inform them fosters the exercise of choice to act differently and with more personally meaningful understanding.

Allied with this issue of emancipation is that of ethical and value judgements.

Ethical and Value Judgements

In their analysis of this issue, Midgley, Munlo and Brown (1998) note that debating boundaries is an ethical process, citing Ulrich's argument that the values adopted will direct the drawing of boundaries that define the knowledge accepted as pertinent; similarly, the process of drawing the boundaries constrains the ethical stance taken and the values pursued.

This double-bind is overcome in complexity terms because the individual simultaneously holds to personal, familial, national and global ethics. Fractality allows no room for conflict between any of its scales of focus (the fractal either exists or doesn't exist at all scales of focus simultaneously), therefore, the global ethic harmonises with the national ethic, familial and personal ethic. Logically, what is ethically good for one fractal level should therefore be good for every other fractal level.

Another aspect of this ethical and value issue is the rationale of the systems and complexity approaches. Systems practitioners seek to create understanding in order to intervene, direct or control the system. In a dynamic, ever-changing and unpredictable world, the best a complexity practitioner can hope to achieve is to make more critical and personally meaningful choices for action (each choice representing a potential bifurcation in the complex world).

The Nature of Improvement

Churchman (1970) argues that something that could be seen as an improvement within a narrowly defined boundary might not be seen as an improvement if the boundary were pushed out. Improvement for systems practitioners is betterment of the single, external reality agreed upon by stakeholders. It supposes a system of more deterministic than adaptive nature. After analysis and discussion, stakeholders have a pre-determined goal, and improvement is the movement towards that goal. It works best when systems are closer to equilibrium than edge-of-chaos.

'Improvement' for a complexity practitioner is more akin to 'enlightenment' of the individual's concerned, that is, development of greater critical or epistemic awareness of the dynamic processes close to the edge-of-chaos. This critical awareness equips them with anticipation and a preparedness to take advantage of and move with any bifurcation and the 'unexpected'.

FURTHER CONSIDERATIONS

Both soft systems practitioners and complexity practitioners subscribe to a relativist ontology: systems, complexity and fractals exist only as mental constructs, relative to the viewer, not 'out there' in an objective reality.

Methodologically, both subscribe to a hermeneutic approach, seeking to make critically explicit individual constructions of reality held by stakeholders. Systems practitioners also engage in dialectic conversation, making use of abductive logic, to arrive at consensus on a single understanding of reality and actions that would constitute an 'improvement' to that reality and the actions necessary to implement it. Systems practitioners work, ideally, as a single unit.

Complexity practitioners, on the other hand, personally contemplate these diverse hermeneutic deconstructions, making use of abductive and fuzzy logic, to discern patterns as the basis for making personal generalisations, using their diversity both to enhance and reshape their own critical understanding of the situation/world at hand and as foils to illuminate future, personally meaningful actions in that world. The notion of virtuality is useful here, where complexity practitioners aim at discovery or creation of virtual connections between events, phenomena and processes that are embedded in social complexity (Dimitrov and Woog, 1997). Such an approach maintains the diversity of ontologies; it does not seek to generate a single, agreed-upon understanding of reality. Complexity practitioners work, pragmatically, as diverse units.

To work with these multiple 'realities', then, requires complexity inquirers to co-relate their intended personally meaningful actions with those of others, adding an additional area for critique and broadening of consciousness. From this broadened consciousness and illumined understanding, the individual can then adjust, reorganise, self-organise, his or her future actions for more personally meaningful ends.

Systems inquiry uses a hermeneutic-dialectic methodology. Complexity inquiry employs a hermeneutic-autopoietic methodology, with differences in the preferred logic systems by which to make sense of 'data'.

It follows that the nature of the knowledge generated by the approaches of both systems and complexity practitioners is subjective, meaningful only to the participants engaged in them.

While there are similarities in the paradigmatic context of both systems inquiry and complexity inquiry, there is also sufficient difference to recognise paradigmatic distinctness for the two.

CONCLUSION

To illustrate the domains of relevance, systems theory and complexity theory can be placed on a continuum representing social states tending to equilibrium, at one end, and to the edge of chaos at the other (see Figure 1).

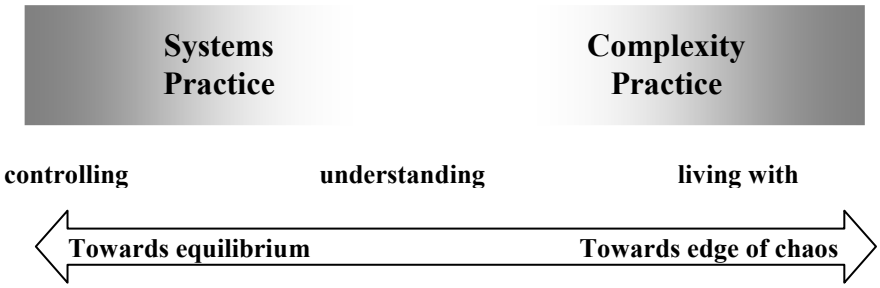

Figure 1: Systems Practice and Complexity Practice on the continuum of the dynamics of social states.

Given the nature of systems practice to control, direct and predict systemic improvement, the discipline, it is proposed, has greater relevance towards the state of equilibrium, where meaningful control can be imposed, leading to improvement. Complexity practice has greater relevance towards the edge of chaos, where there is little control but a greater sense of 'living with' the unpredictable dynamics of the social situation. This illustrates the relevance of setting boundaries for systems practice but irrelevance away from controllable states of equilibrium where a different mindset is needed.

It is hoped this elaboration of these complementary disciplines, with the tools of boundary setting and fractality, offers systemic thinkers a wider paradigmatic perspective from which to undertake their practice.

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