EasyChair Preprint

№ 10255

Can Process-Orientated Meta-Systemic Worldview and Practice Enable Systems Thinking/Dynamics to Better Assist in Navigating Edge of Chaos?

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May 24, 2023

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Can a process-orientated meta-systemic worldview and practice enable systems thinking/dynamics to better assist in navigating the edge of chaos?

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For: UK Systems Society International Conference 2023, St. Hilda's College, Oxford, 14th and 15th September 2023 https://www.systemsforum.org/events/

Abstract:

The epistemological role of world views in informing organisational practice is reconsidered in evaluating the importance of systems thinking to create more sustainable systems in the evolving challenges of turbulent environments. Leadership's admission that it struggles to engage effectively with exponentiating global challenges shows that it is ill-prepared to guide organisations in the complexity of an increasingly recognised 'meta-crisis'. To navigate the anticipated 'edge of chaos' that both accompanies and enables deep systemic change, systems thinking/dynamics is evaluated from the ontological perspective for its potential contribution to enable practical application of 'Reflexive Complex Adaptive Intelligence'. Shifting from the linear mechanistic reductionist, to the non-linear organismic holistic perspective, ought to access and enhance inherent capacities to engage with complexity and emergence more effectively. To this end a potentially generative nexus is examined in the interstices between system thinking/dynamics, insights into the edge of chaos, and holism as dynamical self-organisation to coherent wholeness.

Key words: Epistemology, Ontology, System dynamics, Edge of Chaos, Meta-systemic, Interstitial spaces.

Introduction

"According to Darwin's Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but ... the one that is able best to adapt and adjust to the changing environment in which it finds itself."[1] - Megginson

Ludwig von Bertalanffy (1968) with general systems theory premised that complex systems share organising principles which can be discovered and modelled mathematically. Fifty years later this conference theme reaffirms that systems thinking offers a framework to address the complex, emergent problems related to sustainability. But the acknowledgment that management professionals increasingly struggle to create resilient organisations to manage rapid developments bears further attention. In this digital era increasing expectation is placed on sophisticated computer simulations, employing artificial intelligence, to comprehend and respond to increasing complexity.

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[1] Megginson, 'Lessons from Europe for American Business', Southwestern Social Science Quarterly (1963) 44(1): 3-13, at p. 4.

Authors like James Lovelock (2019), anticipate a coming era of 'hyper-intelligent cyborgs' to help manage human and planetary affairs. Elon Musk's goal for the insertion of a Neuralink micro-computer into the human brain is supposed to improve the communication between humans and AI. Musk declares;

"...humanity will not be able to keep up with the exponential advancement of technology without human-computer 'telepathy'." [2]

The question which thus arises is whether there is a danger of technology taking us in tow by putting that cart before the horse? And that will be divorcing adaptive epistemology from the unpredictable emergence that characterises ontology. That is why is seems significant that in responding to this trend a 2022 McKinsey report cautions that exponential developments in IT is *'...calling into question the very meaning of being human'*.

The question here examined is whether the intrinsic ontological human capacity to sense and respond to complexity, especially when enabled by a holistic perspective, has been overlooked. Is there an even deeper inherent wisdom available to respond to the conference's identified intention of embracing the exponentiating challenge of deep sustainability?

Turbulent context

'Permacrisis' was identified by Collins dictionary as the 2021 'word of the year'. It described *"...an extended period of instability and insecurity..."* and highlighted the struggle of leadership to engage with the exponentiating challenges of a gathering global 'meta-systemic crisis'. What is the contribution of systems thinking/dynamics to providing a more effective platform enabling a deeper exploration of a fundamental transformation of worldview and practice from reductionism to holism?

According to Jeremy Lent (2021), systems thinkers don't reject the basic parameters of the reductionistic science worldview, they argue that at each level of complexity in a system, new properties emerge that can't be understood using methodologies appropriate for lower levels. He emphasised that embracing system thinking activates a conceptual switch that disrupts the foundations of the reductionistic world view. Lent pointed out that systems thinking undermines the sacrosanct distinction between the observer and the observed that allows scientists to claim their methodology is value-free. He quoted Roger Sperry that once principles of complexity and emergence were accepted, *'... the very nature of science itself is changed'*. The implications of a holistic worldview, *"... erode the cleanly defined boundaries on which much reductionistic science is based."*

Against this background a process-orientated holistic approach to complex systems design and planning is explored with the core theme of navigating Kaufman's (1991) 'edge of chaos'. Described as the transition space between order and disorder existing within a wide variety of systems, the 'edge of chaos' transition zone is described as a region of bounded

[2] https://www.biznews.com/news/2022/12/01/elon-musk-computer-human-brain

instability that engenders a constant dynamic interplay between order and disorder. As a consequence we offer 'Reflexive Complex Adaptive Intelligence' (RCAI) as an approach enabling practical application of the potentially deeper wisdom emanating from a transformed worldview. Ultimately, as is here emphasised, it requires an enhanced capacity of 'sensing'.

Sensing

Our inquiry is how a deeper quality of 'sensing' can help transfer dependency on linear and reductive thinking to non-linear, process and pattern-detecting intuitive awareness. Rather than abrogating responsibility for our existential opportunities and challenges to 'cyborgs', can we endeavour to remain free and responsible agents, recognising, from complexity theory, the process of autopoiesis and creative co-evolution? The challenge of transferring responsibility for dealing with complexity to computers not only raises the question whether the technological product of human ingenuity can be greater than its creator, it also has critical ethical implications. Jan Smuts, *'Holism and Evolution'* (1926), insisted that human responsibility was a measure of evolving personality. Stamping autonomy on ethics he declared; *"The function of the ideal of freedom is to secure the inward self-determination of the personality."* Addressing the British Association for the Advancement of Science (1931), Smuts revealed how studying the work of poets like Goethe and Whitman he realised there was something greater in them than in their works. It is this 'inner quality' that we examine to ascertain whether accessing an even greater potential of human consciousness, augmented by advanced technology, might even presage an epochal shift.

Irwin Lazlo in his preface to Enrico Cheli (2010) addresses a more inclusive quality of consciousness;

"...The mechanistic and reductionist paradigm of Logos is no longer capable of ordering the mushrooming complexity and increasing vulnerability of globally extended interdependent technological societies. Society is confronted with the challenge of another transition: beyond Logos, to a societal paradigm we can best describe with the term 'Holos.'"

As Lazlo emphasises, the transition from Logos to Holos of necessity moves from the conventional empirical scientific paradigm, essentially reductionistic and focused on inductive reasoning, to a holistic worldview and practice. This is more inclusive of deductive and abductive awareness and characterised by sensing and process-response. With this perspective 'Reflexive Complex Adaptive Intelligence' is offered as a practical alternative to support the shift from a mechanistic perspective to organismic information processing. In this way we can avoid the pitfalls of an increasing schism between epistemology and ontology.

Thrust forward

How then do we respond to the rising challenge to systems thinking already stimulated by Jay Forrester (2007). Declaring that the first 50 years of system dynamics had essentially only established an introduction to the field, he emphasised its importance to achieve a better

understanding of complex systems in nature and human affairs. His paper suggested the field was on a plateau, 'ready to launch the next great thrust forward'. Significantly he declared:

"We have ... much to learn yet about high-order nonlinear feedback structures around us ... (to) start to close this huge knowledge gap."

Consequently we explore how to more effectively employ systems thinking/dynamics in the 'edge of chaos' context by accessing holistic awareness. Might this help close Forrester's '*huge knowledge gap"*?

Change of era

In 2015 Pope Francis suggested that humanity found itself, not in an era of change, but in change of era. And a colleague, the late Lawrence Bloom, suggested that humankind was facing an intelligence test.

"If we fail the consequences will be ghastly - if we succeed the potential for humanity is beyond imagination."

Pope Francis' change of era, whilst relating to the Catholic church, is generally endorsed in the McKinsey report referred to above. Entitled *'On the Cusp of a New Era',* Bradley et al (2022) isolate five dynamical agencies feeding into the change of era; (i) the multi-polarity of the world order, (ii) a new wave of technology platforms, (iii) the growing inequality in demographic forces, (iv) climate change and resource and energy systems, and (v) capitalisation and new engines of economic growth. These dynamical agencies all clearly have bearing on the 'social and environmental responsibilities' identified as the focus of this conference. For example, in respect of technology platforms, *'calling into question the very meaning of being human'* the authors ask:

"*What impact will the next wave of technologies have on work and social order? How will technology, institutions, and geopolitics interact?"*

In respect of resource and energy systems, in the face of 'underinvestment and geopolitical disruption' they ask:

"*How will the world navigate an affordable, resilient, and feasible path to climate stability? What dynamics will play out between those who have critical resources and those who do not?"*

The report concludes: *"If we are indeed in the early throes of a seismic shift—as the evidence appears to suggest—leaders must both prepare for the possibility of a new era and position themselves to shape it."*

Whilst the McKinsey report anticipates the upside of economic and social possibilities in the prospect of such a seismic shift, complexity thinker, Edgar Morin, was especially concerned about the geopolitical polarisation precipitated by the ongoing conflict precipitated by the

Russian invasion of Ukraine. He wrote in 2022: *"Today, once again I see us on the brink of an abyss, and in the absolute uncertainty of tomorrow."*

Human consciousness

Clare Graves' bio-psychosocial model of emergent adult values, further developed by Don Beck et al., and endorsed by thinkers such as Ken Wilber and Frederic Laloux, identifies a significant conceptual shift from 'first tier' mechanistic linear, to 'second tier' organismic non-linear thinking. How might a better understanding of the state of emergent human consciousness that has given rise to this anticipated 'change of era', enable us to navigate through it? The shift, as Lent shows, must also include our scientific worldview. Thomas Kuhn (1962) coined the term 'paradigm shift' to describe fundamental changes in scientific perspective. Just over forty years later Roger Penrose (2005) emphasised that there are still mysterious issues about which science has very little comprehension.

"It is quite likely that the 21st century will reveal even more wonderful insights than those that we have been blessed with in the 20th century. But for this to happen, we shall need powerful new ideas, which will take in us directions significantly different from those currently being pursued. Perhaps what we might need is some subtle change in perspective - something we have all missed…".

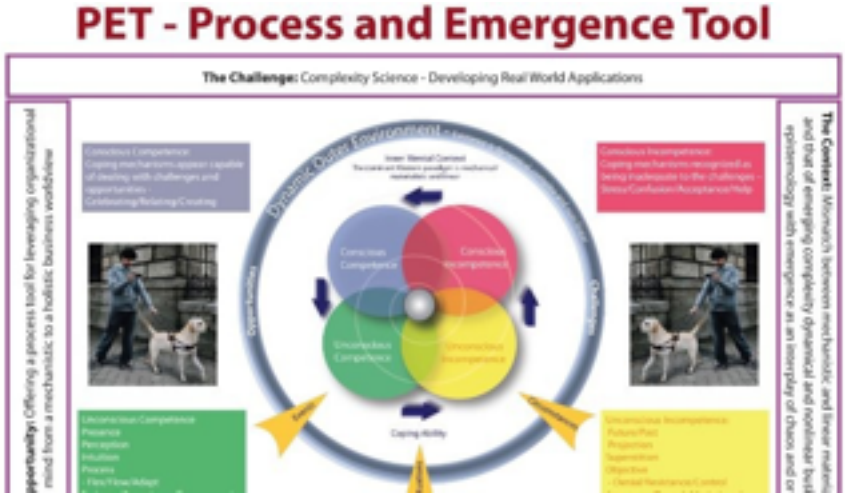
Reflexive Complex Adaptive intelligence

The McKinsey challenge to leaders to 'prepare for the possibility of such an new era', and especially '...position themselves to shape it' serves to endorse the evaluation of Reflexive Complex Adaptive Intelligence. It offers a process to engage in a more holistic way with the phenomenon of complexity and emergence. Proceeding from the phenomenological perspective it addresses Lent's (ibid) observation of the impact of the holistic perspective on so-called scientific objectivity. Thereby we contend it is better positioned to address the societal and personal changes involved in addressing sustainability as identified as discussion for this conference.

The core premise of the RCAI approach, van Wyk (2020), is based on the insight from complexity theory that autopoiesis characterises all living systems and ultimately defines *adaptive intelligence.* Identifying eight phases of reflection, RCAI; (i) seeks to identify the problem-space with sensory specifics,(ii), establish the longer-term meta-outcome for addressing the problem-space, (iii) differentiate between a 'complicated' or 'complex' issue, (iv) subjectively position the problem-solver at the centre of the problem-space both in terms of attitude and values-enabled worldview, (v) map the problem space in respect of agencies, variables, causal feedback-loops and potential externalities, (vi) enter the collaborative space of exploring opportunities, (vii) generate multiple scenarios of interaction with influenceable agencies, (viii) curate the insight and learning from each dimension.

In positioning the problem-solver at the centre, RCAI enables agile response to those hitherto unrecognised subtle signals indicating when approaches have become dysfunctional. This is emphasised since we consider whether such an enhanced capacity to apprehend more subtle

signals with an enhanced quality of sensing might address Penrose's 'subtle change in perspective'? The approach thus includes a 'Process and Emergence Tool' to help determine the functionality or dysfunctionality of response to the dynamical context.



Human onto-intelligence

Resonating with the notion of complex human adaptive intelligence, Peter Belohlavek, (2015), offers the term 'human onto-intelligence' as based on considering human beings in their complexity and the application of the principles of the ontogenetic 'intelligence of nature'. Individuals, he asserts, can only assume the results of what they are doing if they have the concept of it. Thus, for this investigation, the contention of 'having a concept' asks whether an even more creative relationship between 'onto-intelligence' and the simulations of system dynamics has been optimised. Belohlavek claims:

"Onto-intelligence allows individuals to apprehend the nature of the environment they are dealing with and defines their adaptive behaviour. Adaptiveness, as the purpose of human intelligence, is defined by the capacity of individuals to influence the environment in order to achieve an objective while being influenced by it."

Three core observations have been offered set the context for the potential contribution of systems thinking/dynamics to managing complex human affairs. First is the notion of a fundamental meta-systemic change of era bringing humankind to the 'edge of chaos', and recognising the accompanying challenges to leadership. Second is re-evaluating our current state of consciousness to progress to a greater form of adaptive intelligence. This is a re-evaluation of the limits to creativity imposed by conventional scientific paradigm.

In reflection on Forrester's 2007 challenge, we now begin examine the nexus of three themes; (i) systems thinking/dynamics, (ii) edge of chaos, and (iii) holism. With Penrose we might ask whether we are missing something? With Forrester we can ask; What might we have overlooked, especially about '*... the high-order nonlinear feedback structures around us.'*

System thinking/dynamics

Reflecting on system thinking, Kerry Turner (2021), declares:

"...You are a system, and so am I. We form more systems through our inter-relationships with others and the world. Ultimately, the biggest system of all is the Universe. Technically, this is THE SYSTEM. All other systems are sub-systems of this one Whole."

With this contention Turner echoes Carl Calleman (2022) who declares:

"The entire universe is then found to be one living entity, in which all the different levels are connected through macrocosmic entanglement in a holographic structure, where the human mind is related to different levels of the cosmos."

Turner reminds that in the study of feedback in systems a change in an element causes a further change to that element in future. From a system dynamics perspective she asserts there are two kinds of feedback; reinforcing feedback, as virtuous or vicious cycles, and balancing feedback. Exponential behaviour patterns, she identifies, emerge from reinforcing feedback. This vital understanding related to cybernetics, informatics and systemics, of necessity falls outside of the space of this inquiry.

Forrester's challenge

However in analysing and modelling behaviour in complex environments, system dynamics is seen as differing from others in that the analysis of the effects of causal loops can represent the dynamics of system behaviour in mathematical models.

Arguing that making system dynamics simple was a 'losing game' Forrester asserted that the problems of complex feedback systems were not simple. Reversing popular but harmful policies necessary to improve society was not simple.

The simplified dilution of the field only served to fail and discredit system dynamics. Whilst others might differ from Forrester's argument, his contention of the limits of the human mind does need careful consideration. He declares:

"It has been repeatedly demonstrated that the human mind is not suited for solving high-order dynamic feedback systems ... Only by going the full road to extensive computer simulations is one prepared for the depth of understanding required in real-world situations."

Against this challenging assertion we reflect on systems thinking/dynamics in an 'edge of chaos context', and reconsider the potential capacities of the human mind. We bear in mind Turner's caution that, no matter how sophisticated computer simulated models may be, they

remain machine models of reality - not reality itself. They will simulate how the modelled structure will behave - not how reality will behave.[3]

The interstitial space thus between systems thinking/dynamics with 'edge of chaos' must take into account that the modelling can only be based on the identified variables. We can assume other variables (externalities) but we cannot predict them. 'Emergence' is about novelty, the unpredictable. Physics can predict the trajectory of a kicked football, but it cannot predict the mood or state of the kicker. Whilst it can predict the ball's movement following the kick, if it was a dog at the receiving end, it can't predict the dog's response. That response could include the relationship of the dog to the kicker.

This interstice between system thinking/dynamics and 'edge of chaos' is more readily the domain of theories of complexity and emergence, outside of this inquiry, with identified dynamics of diversity, autonomy, self-organisation, co-evolution, etc.

"All models are wrong; some models are useful." — W. Edwards Deming

Edge of Chaos

In his address to British scientists in 1931, as quoted above, Smuts said:

"Under the double influence of the internal genetic and external environmental factors life has subtly adapted itself to the ever changing situations on this planet ... in the process of this evolution not only new structures and organs, but also new functions and powers have successively appeared..."

For Steven Strogatz (1994), since adaptation played a vital role for all living organisms and systems, all of them were constantly changing their inner properties to better fit in the current environment. The most important instruments, the self-adjusting parameters inherent for many natural systems, was the ability to avoid chaos, named, *"Adaptation to the edge of chaos"*. In complex adaptive systems coevolution is argued to occur near the edge of chaos requiring balance to be maintained between flexibility and stability to avoid structural failure.

From the edge of chaos perspective thus, the response to coping with turbulent environments requires flexibility, creativity, agility, anti-fragility and innovation near the edge of chaos.

Adaptation to the edge of chaos refers to the idea that many complex adaptive systems seem to intuitively evolve toward a regime near the boundary between chaos and order. Meanwhile Stuart Kaufman (1993) in studying mathematic models of evolving systems found the rate of evolution is maximised near the edge of chaos.

It will be shown hereunder that Smuts employs the notion of holism to describe that process of intuitive evolution.

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[3] The report that Europe intends to build a virtual world bears reference: https://www.science.org/content/article/europe-building-digital-twin-earth-revolutionize-climate-forecasts

Social and ecological dynamics

Relative to the challenges of this conference, Romina Martin and Maja Schluter (2015), point out that when integrating social and ecological dynamics, often studied separately, one has to deal with different modelling paradigms, levels of analysis, temporal and spatial scales, and data availabilities in the social and ecological domains. Significantly they declare:

"A major challenge, for instance, is linking the emergent patterns from individual micro-level human decisions to system level processes such as reinforcing feedbacks determining the state of the ecosystem."

The authors continue that when considering the term ecosystem, there could be a fruitful examination of relationship between those 'emergent patterns' and Kaufman's notion of 'edge of chaos'. This view highlights the importance of production 'on the edge of chaos' to yield valuable change in self-organising systems spanning thermodynamic, economic, and biochemical systems.

How then does ecosystem relate to the notion 'edge of emergence?' In the *'Complexity Intelligence Strategy'* (2017), where the World Scientific explores the fundamentals of complexity theory and human complex adaptive systems, 'edge of emergence' is suggested to offer a more comprehensive explanation of the complex adaptive dynamic and emergence. The authors suggest that this new comprehension indicates that a re-calibration in thinking is essential.

"In the human world, high levels of human intelligence/consciousness (the latent impetus that is fundamentally stability-centric) drives a redefined human adaptive and evolution dynamic encompassing better potentials of self-organisation or self-transcending constructions."

Edge of chaos - biology

According to Kaufman: *"Complex systems, contrary to expectations, can spontaneously exhibit stunning degrees of order ... essential for understanding the emergence and development of life on Earth."*

From a biological perspective Christian Darabos et al. (2009) investigated the essence of Kaufman's model to test the assertion that the cells of living organisms functioned in a near chaotic regime. This 'state', which the call 'critical, is considered to offer a trade-off between stability and evolvability. The authors investigated the dynamical behaviour of two real-life genetic regulatory networks, deduced in two different organisms. Of particular significance for the purpose of this inquiry was that they investigated a novel, more biologically accurate, way individual genes respond to activation signalling. Performing numerical simulation and successfully identifying contexts in which their model's response could be interpreted as critical, and thus most biologically plausible, they discovered that results were comparable in both studied organisms.

Edge of chaos - cognitive science

From a cognitive science perspective Robert Bilder and Kendra Knudsen (2014) expand on Kauffman's new and useful developments emerging 'on the edge of chaos,' as they put it, the boundary between ordered and chaotic regimes. The Edge of Chaos theory, they assert, can be applied to cognitive processes and brain activation states important for creative cognition. In considering the diversity of possible cognitive states the highly predictable and orderly can be differentiated from the unpredictable and chaotic. In more chaotic regimes, network states are more disconnected from those in the ordered regime.

"... At the edge of chaos' the states are maximally novel while still connected to states in the ordered regime, and thus are most likely to manifest the combination of novelty and utility that is the hallmark of creativity" .

As an example of such construction in dealing with the edge of chaos, beyond short-term objective, Max Langosco (2012) highlights the limitation of management tools based on a linear deterministic approach as insufficiently agile for success. Emotional, cultural, and spiritual intelligence tools are required to support project managers in maintaining the difficult balance characteristic of the 'edge of chaos' necessary in complex projects.

For Langosco the state called 'edge of chaos' is the most efficient, with just enough structure to permit some order, but without reducing flexibility and innovation.

"Life itself can only exist on the Edge of Chaos,... this fertile state does not hold itself because it is not a stable balance point. In order to maintain this dynamic balance point, effort and energy must be applied."

Langosco affirms that in CAS new behaviours emerge which would not have been foreseeable by observing only the single agents. It is at the 'edge of chaos', that these emergent behaviours can occur. From the CHAI perspective thus navigating the 'edge of chaos' invites a reframed perspective. On the one hand 'chaos' can be seen as destructive of order, on the other hand edge of chaos can be seen as the state in which creative emergence, life itself, is enabled.

Lent (ibid) implicitly touches on this interface of 'edge of chaos' perspectives and holism when he points out that systems thinking undermines the sacrosanct distinction between the observer and the observed that allows scientists to claim their methodology is value-free.

"Once you recognised you are embedded in the very system you are observing, your sense of reality changes. You realise that the way you approach whatever you are studying may affect it and may impact your own perception of it."

This is why with the RCAI approach the problem solver is placed in the centre of the problem space where the values-based perspective, as well as mood or attitude, can be recognised, taken into account, and adapted to the context.

Echoing Kaufman, Eve Mittleton-Kelly (2003), also quoting Prigogine on dissipative systems, argues that disruption of existing stable systems can indeed lead to bifurcation, either to disintegration, or to emergent 'new order'.

It follows that it is 'how' the state 'edge of chaos', is engaged with, that could influence the trajectory towards disintegration or new order.

It also would follow then that engagement with the turbulent context, when accompanied by an evolutionary scientific paradigm shift, might enable us to re-imagine 'new order' to be enabled by generative engagement in 'edge of chaos'.

Consequently we now proceed to examine the holistic perspective and practice, what it is, what it can contribute, and how to cultivate it with a view to addressing the seemingly intractable challenges, a veritable quagmire of complexity, identified thus far.

Holism

Smuts claimed that it was his study in dynamics that enabled him to get a fundamental grasp of Einstein's relativity. This helped him reformulated his ground-breaking approach of holism. In emphasising the need for meta-frameworks that have the capacity to integrate the overwhelming amount of information available into a more coherent and meaningful worldview, Guy Du Plessis and Weathers (2010). reassess the 'overlooked contribution of holism'. They observe that whilst Smuts' theory of holism is seldom acknowledged, he can be counted amongst the great integral thinkers of the 20th Century. His notion of Holism had a significant influence on the development of Integral Theory.

"Today, the concept holism is common place in many fields of study for example, physics, general systems theory, biology, anthropology, medicine, cybernetics, holography (etc)."

Holism offers a way to address the need for meaning-making meta-frameworks, as also stressed by Lazlo, on the shift from Logos to Holos. Emphasising the significance of holistic systems thinking as going beyond the bounds of scientific disciplines he asserts that society itself needs to change paradigms.

Holistic complex systems design and planning:

From the practical perspective, the shift to Lazlo's 'Holos', will also require the adoption of new design principles and practice, bearing in mind, as Daniel Wahl (2017) stresses, that the co-design of complex systems is not terminal but a continuous process.

"As nature, the containing system, is undergoing constant change, the adaptations we are designing in response to natural conditions will also have to be flexible enough that they can accommodate such changes over the short and long-term."

In complex system design and planning, Terry Irwin (2011) argues that a better understanding of the principles and dynamics of healthy ecosystems could aid in designing more

appropriately and responsibly. Principles from chaos and complexity theories, emergence, self-organisation, fractal structure, feedback loops, attractors etc, can be explored within the context of design.

Marcello Arioso et al (2018) point out that most commonly, the risk of a system is estimated through a reductionist approach, based on the sum of the risk evaluated individually at each of its elements. In contrast, a holistic approach considers the whole system to be a unique entity of interconnected elements, where those connections are taken into account in order to assess risk more thoroughly. Echoing the intention of system dynamics, to support the requisite paradigm shift, they propose: *"... A holistic approach to analyse risk in complex systems based on the construction and study of a graph, the mathematical structure to model connections between elements."*

Michael Jackson (2006) in turn identified a critical systems approach, 'creative holism', to help managers address complex problem situations. Echoing Forrester he asserts that whilst managers face increasing complexity, change and diversity, the solutions they are offered to help them cope in this situation rarely seem to work. It is argued that those solutions fail because they are not holistic or creative enough.

"The benefits to be gained from holism and creativity (in a systemic sense)... and a practical approach, 'creative holism', ... aims to better equip managers to deal with complex problem situations ... systemics has the potential to have both a significant and a beneficial impact upon society in the years to come."

Holism, he asserts, deserves to be reinstated as an equal and complementary partner to reductionism.

"It encourages the use of trans-disciplinary analogies, it gives attention to both structure and process, it provides a powerful basis for critique, and it enables us to link theory and practice in a learning cycle."

Holism does not attempt to break organisations, or other entities, down into parts in order to understand them and intervene in them. It concentrates its attention at the organisational level and on ensuring that the parts are related properly together and are functioning well to serve the purposes of the whole.

Significantly Jackson, echoing Wahl, identifies a benefit deriving from holism as the capacity to recognise the importance of both process and structure in system development and maintenance, and their interdependence. Pointing out that Von Bertalanffy was interested in the processes that give rise to the steady state that biological organisms are capable of exhibiting, he shows that complexity theory has taken this much further, picturing systems as arenas of dynamic process from which stable structures are temporarily born. Order is an emergent property of disorder and comes about through self-organising processes operating from within the system itself. Stressing that Maturana and Varela's distinction between 'structure' and 'organisation' adds further insight, Jackson reminds that Maturana (1986) defined a dynamic composite unity as *'a composite unity in continuous structural change*

with conservation of organisation'. In general terms, all the different systems methodologies are able to take advantage of the ability to conceptualise structure and process as interrelated.

A further benefit Jackson identified for holism is the 'theoretical awareness' to which it gives rise. When we distinguish systems and identify their characteristics, we clearly do so from a particular world-view. Knowledge is, therefore, always partial. It is necessary, therefore, to reflect upon the world-view being adopted and to compare what it reveals to the knowledge obtainable from an alternative world-view. Doing so can also help develop a closer link between theory and practice.

Critical systems thinking (see Jackson, 2000, 2003) frequently asks what paradigm is driving our world-view or what metaphors we are privileging in our world view, in order to progress theoretical awareness and the critique to which it can give rise. This form of critique is more fundamental than the 'boundary critique' mentioned earlier because the worldview or paradigm we adopt tends to determine how we see boundaries.

Jackson's observation brings us to the interstitial space between holism and system thinking/ dynamics. Whilst these methodologies do provide a more comprehensive lens with which to analyse the variables and dynamics of complex systems, holism enables comprehension of the whole dynamical system in its own behaviour. There is implicit understanding that in the viewing we are intrinsically operative factors in its functioning. From holism author, Jan Smuts', perspective, the most critical shift is from seeing the world as consisting of things (materialism) to seeing it as consisting of action (organicism).

Discussion

The challenge to this conference has been how to better enable resilient organisation in addressing sustainability in a turbulent and uncertain context. It is suggested that humanity stands on the threshold of a change of era. Bloom suggested that the challenges being faced can be considered to present a human intelligence test with inestimable consequences. The notion of 'edge of chaos', or Langosco's 'edge of emergence' has been briefly examined and Mittleton-Kelly's prospects of bifurcation to either disintegration or new order contemplated. Whilst computation is often considered to hold further capacities to deal with complexity, thinkers have pointed out that addressing the real challenge inevitably involves a transformation of human consciousness. For Lazlo this era change could be seen as a shift from a reductionist and mechanistically informed worldview, 'Logos', to a holistic and organismic worldview, 'Holos'.

Generative interstices

Systems thinking has been investigated for its greater unrealised potential. We suggest that the difference between systems thinking, complexity theory, and holistic awareness, might be less about the models, and more about the consciousness behind the awareness and response. A more generative nexus for addressing the requisite quality of consciousness could be sought in the interstices between the methodology of system thinking/dynamics, insights into the edge of chaos, and the holistic perspective. The interstice between systems thinking and

‘edge of chaos’ might thus more readily be further explored in the theories of complexity and emergence with dynamics of diversity, autonomy, self-organisation, and co-evolution.

The interstice between ‘edge of chaos’ and holism can now be identified in the understanding that in a universe of perpetual action ‘edge of chaos, or ‘edge of emergence’, provides the very conditions for either ‘new order’ or disintegration. Significantly it emphasises that in our complex environment human agency is directly involved.

Forrester suggested system dynamics was on a plateau ready for the next thrust forward in order to better address high order non-linear feedback structures. this challenge. We suggest addressing Forrester’s with system dynamics will be better enabled with the holistic perspective. To achieve implementing the holistic perspective and practice the concept and processes of complex human adaptive intelligence (CHAI) is offered. Showing resonance with Belohlavek’s onto-intelligence and Jackson’s creative holism, holism is emphasised by Wahl and Arioso et al as the core perspective requirement of sustainable design and planning.

Ultimately we conclude a change of paradigm, a progressive shift in consciousness must boil down to enhanced ‘sensing’. David Snowden and Boone (2011) with the ‘Cynefin framework’ help illustrate four qualities of the problem-solving challenge presented to individuals and organisations. From a linear perspective, simple problems require sensing and action calling for the application of best practice protocols. Complicated problems require sensing and response employing thorough analysis by requisite expertise to be followed by good practice. From the non-linear perspective complex problems and situations require enhanced sensing with experimental probing, exploration, and observation to detect trends which can be amplified or dampened. Chaotic situations demand sensing, response through clear action to provoke further response. In all these cases Snowden’s model emphasises ‘sensing’ as the initiating experience to be recognised.

Presence

We suggest that from the appropriate stance and response perspective, ‘edge of chaos’, can also be described as the condition at the interstice between the Cynefin model complex and chaotic states. That is why when Reflexive Complex Adaptive Intelligence (RCAI) is offered as a phased process for engaging with presented challenges and opportunities, the subjective involvement of the would-be problem-solver is emphasised.

Ultimately enhanced consciousness boils down to enhanced presence. With open perceptual filters, seeing more, hearing more, especially including response to subtle internal signals as intuitions, and feeling more, the wholeness of a context might be more easily apprehended. Tools, such as system thinking/dynamics, employed to enhance comprehension of feedback loops, etc., can be enabled to bring even greater value. Aaron Antonovsky’s ‘Salutogenesis’ refers to the requirements for a ‘wholesome’ sense of coherence as comprehensibility, manageability and meaningfulness. It is suggested that when we have a more comprehensive understanding of our co-creative role in evolution, our responses and engagement can become more generative and meaningful. ‘Presence’ will enable ‘Agility’. More subtle agile response will generate more effective ‘Engagement’. Greater engagement will enable greater

collaborative effort and enhanced resilience. And that combination together must surely elicit deeper collective wisdom, ingenuity and creativity.

Conclusion

The case for Reflexive Complex Adaptive Intelligence has been presented as an organismic information processing methodology to assist systems thinking/dynamics to begin to open the door to holistic perception and response. Thereby leadership's capacity to deal with the uncertainty of the anticipated 'edge of chaos' global epochal transition, could be supported with access deeper wisdom from enhanced sensing. This in essence will transfer dependency on linear and reductive thinking to non-linear, process and pattern-detecting intuitive awareness. The epochal shift thus from the conventional (Logos) empirical scientific paradigm, to include deductive and abductive awareness and process-response, described as 'Holos'. Its contribution to potentially empowering systems thinking to bridge the epistemology/ontology schism bears further research.

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