Essentials of Applying Complexity Thinking for Sustainability Leadership

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This document serves as a tool to support leaders and change agents who work with sustainability issues to better apply the principles of complexity thinking. It is not intended to be a thorough overview of complexity theory or complexity leadership. Rather, it is an introductory reference document that highlights some of the key concepts and principles concerning its application.[1]

The first part of this article offers a summary of important guidelines regarding complexity leadership. Secondly, a list of terminology is presented, focusing on: complex vs. complicated; characteristics of a complex system; interaction; dynamic; adaptation; emergence; complex adaptive systems; mechanisms; self-organized criticality; and dissipative structures.

The third section consists of a brief overview of complexity leadership theory. This includes a section about the "myths" of leadership that are dispelled once a complexity lens is taken on. The fourth section is an explanation of specific leadership practices and recommendations as related to complexity theory. I conclude with the recommendation that sustainability leaders use this tool in service of navigating their initiatives, yet also encourage people to use this lens lightly and be willing to put it down in service of seeing more than it can offer.

[1] The following material is drawn from the article "Complexity leadership: An overview and key limitations" (Brown, 2011). For further study, see: (Goldstein, Hazy, & Lichtenstein, 2010; Hazy, Goldstein, & Lichtenstein, 2007; McMillan, 2008; Stacey, 2007, 2010; Stacey, Griffm, & Shaw, 2000; Uhl-Bien & Marion, 2008; Wheatley, 2006).

Six Complexity Leadership Guidelines

If you want to put complexity leadership theory into action, the following are prominent recommendations from the research. These generic principles are further explained below in the section titled "Toward a Practice of Complexity Leadership."

1. Scan the system continuously and pay attention to patterns, emergent behaviors, multiple causal loops, and the impact of small fluctuations.
2. Allow the behaviors of individuals or systems to emerge, rather than trying to control them.
3. Only set broad orienting values, creating the condition for the system to generate the most timely and appropriate specifics.
4. Dance with the system – adapting along the way and focusing on creating the conditions for emergence – rather than trying to chart and follow a linear path.
5. Don't feel that you need to keep the system in constant harmony but allow disequilibrium; novel structures and innovative ideas often emerge out of destabilized states.
6. Cultivate experimentation, novelty, and prototyping; these support the emergence of small successes that can become positive deviance to be scaled across a system.

Finally, my personal recommendations are to have fun surfing the unknown, don't get stuck in trying to conceptually figure this all out, and trust that you've got what you need within your network to support system development.

Key Terminology of Complexity Leadership[2]

The following concepts are instrumental for understanding and working with complexity theory as a leader or change agent.

Complex vs. complicated
In the complexity sciences, the term "complex" does not mean the same as "complicated." A system is complicated if each of its individual components or constituents can be described (even if there is a huge number of them). For example, computers or jumbo jets are complicated systems. A system is complex if its relationships cannot be explained fully by merely analyzing its components because they are dynamic and changing. The brain, for example, is a complex system (Cilliers, 1998 cited in Uhl-Bien & Marion, 2009). The term complexity is meant to impart the sense of deep interconnectedness and dynamic interaction that results in emergence within and across *complex adaptive systems* (described below). Complexity generates novel features, often called emergent properties. Other examples of complex systems that generate emergent properties due to being richly interactive, nonlinearly dynamic, and unpredictable are the rainforest, natural language, and social systems (Cilliers, 1998; Snowden & Boone, 2007; Uhl-Bien & Marion, 2009).

Characteristics of a complex system (Snowden & Boone, 2007)
Complex systems incorporate myriad interacting elements. The interactions between these elements are nonlinear and minor changes can cascade into large-scale consequences. Such systems are dynamic, with a whole greater than the sum of its parts. It is not possible to impose solutions or order upon them; rather, such novel forms arise from the circumstances within them (called *emergence* – discussed below). The elements of complex systems evolve with one another, integrating their past with the present, and their evolution is irreversible. Due to the constant fluctuations and changes of external conditions and connected systems, complex systems are not predictable, although they may seem ordered and predictable in retrospect. As such, no forecasting or prediction of their behavior can be made. This is due to the fact that individual elements and the system itself constrain one another over time. Such mutually constraining behavior is different than in ordered systems in which the system constrains the elements, or in chaotic systems which have no constraints.

Interaction
Complexity theorists study the "patterns of dynamic mechanisms that emerge from the adaptive interactions of many agents" (Marion, 2008, p. 5). When sentient agents (like humans in an organization) interact, they change due to the influence of relationships, interdependent behaviors, and the emergence of subsets of agents that engage one another interdependently. The structures, dynamic behaviors, and patterns that arise from these complex interactions become unrecognizable when perceived as linear combinations of the initial actors. These interactive behaviors and outcomes ultimately create feedback loops with each other, leading to effects becoming causes and influence arising from extensive chains of effect.

Dynamic
Complexity does not refer to static events. Rather, it concerns a dynamic process that consistently changes its elements and brings forth new things in a process called emergence (described below). While there is global stability and resilience within complex systems and complex behavior, they are fundamentally defined by change.

Adaptation
Adaptation refers to a complex system's ability to strategically change or adjust in response to individual or systemic pressures. Adaptation arises at two levels, the individual and the aggregate. Individual adaptation concerns local stimuli and individual preferences. Individual adaptations amongst agents in a system can interact with each other, resulting in compromises that simultaneously serve the individual and the collective, thus forming aggregate adaptation.

Emergence
Emergence is "a sudden, unpredictable change event produced by the actions of mechanisms" (Marion, 2008, p. 9). It is a type of naturally occurring change and subsequent stabilization into a new order that is "free" – meaning that it does not require external energy to happen. It can result in dissipative structures. When complex systems are dynamically interacting, they often generate many low-intensity emergent changes; occasionally they experience a high-intensity change. These changes are different than those which arise through steady, step-by-step trajectories from known beginnings through predictable outcomes. Emergence arises through interaction and energic pressure as opposed to the actions of any lone individual. It is the dynamic actions of mechanisms that generate it, rather than the constant, predictable effect of variables.

[2] The explanations for all of these elements, except "complex vs. complicated," "characteristics of a complex system," and "complex adaptive systems, are from Marion (2008).

Complex adaptive systems

The complex adaptive system (CAS) is a very important element in both complexity science and complexity leadership theory. It is the basic unit of analysis in both. According to two prominent researchers (Uhl-Bien & Marion, 2009, p. 631), complexity leadership is about leadership "*in* and *of* complex adaptive systems, or CAS" (Cilliers, 1998; Holland, 1995; Langston, 1986; Marion, 1999). CAS are open, evolutionary aggregates – neural-like networks – of interacting, interdependent agents who are cooperatively bonded by a common goal, purpose, or outlook (Cilliers, 1998; Holland, 1995; Langston, 1986; Marion, 1999; Uhl-Bien, Marion, & McKelvey, 2007). Arising naturally in social systems, CAS learn and adapt rapidly and are capable of creative problem solving (Carley & Hill, 2001; Carley & Lee, 1998; Goodwin, 1994; Levy, 1992; as cited in Uhl-Bien, et al., 2007). Complexity theorists essentially frame organizations as complex adaptive systems that are composed of heterogeneous agents that interact and affect each other, and in the process generate novel behavior for the whole system (Marion & Uhl-Bien, 2001).

Mechanisms

In general, mechanisms are processes that result in given outcomes (Hëdstrom & Swedberg, 1998, as cited in Marion, 2008). There are certain, universal mechanisms that drive complex dynamics. When change occurs, it is these mechanisms at work. Complex mechanisms are emergent behavior patterns, universally available, that enable a dynamic mix of causal chains and agents. An aspect of complexity theory is to identify and describe complex mechanisms and the patterns that arise from their interaction. There are four key complex mechanisms. First, *correlation* arises through the interaction of agents as they share part of themselves (technically called their "resonance," but loosely can be understood as their worldview, assumptions, beliefs, preferences, etc.). Correlation brings about bonding and *aggregation*, which is the second mechanism. Aggregation represents the clustering of multiple agents due to the development of shared or interdependent resonances. Autocatalytic mechanisms are the third type. These are emergent structures and beliefs that catalyze or accelerate other mechanisms. For example, deviant behavior like looting can be autocatalyzed by rioting behavior. The fourth key mechanism is nonlinear emergence. This mechanism is experienced as a sudden shift in dynamic states. An extreme example is the demise of the Soviet Union; another would be the transition of water from liquid to solid.

Self-organized criticality

Self-organized criticality (Bak & Tang, 1989; Kan & Bak, 1991) and far-from-equilibrium dissipation (Prigogine, 1997) are two causative mechanisms that lead to nonlinear emergence. Self-organized criticality refers to instances in which a minor event can lead to chaos, driving large interactive systems to a critical state (Kan & Bak, 1991). Within complex, interacting systems of many agents, it represents sudden, unexpected shifts in structure or behavior. These emergent shifts are not "caused", but rather happen due to the dynamic, random movements within complex systems. They occur as these complex systems are randomly exploring and come within range of – and "fall" into – a complex attractor. Dramatic shifts in the stock market or the onset of looting in riots are examples of these attractors that draw in systems that come close enough to their basins of attraction. Criticality cannot be influenced by external agents, such as leaders or environmental pressures.

Dissipative structures

Dissipative structures are the order that emerges from the dissipation of energy. Typically, dissipation refers to the entropy and deterioration of order that results with the release of energy. The creation of order is normally associated with increased energy. Prigogine (1997) however, identified dissipative structures that do not result in deterioration, but an increase in order with the release of energy. An example is when oil is heated slowly. For some time it demonstrates little change (no new order). Once the oil reaches what Prigogine (1997) called a "far-from-equilibrium" point – in which the energy builds to an unstable level – the oil molecules release energy, break the tension, and shift into a gentle boiling roll. As opposed to criticality, dissipative structures can be influenced by external agents, like leaders and environmental pressures.

Complexity Leadership Theory Fundamentals

The science of complexity theory concerns the study of complexly interacting systems (Marion & Uhl-Bien, 2001). Complexity theory has been defined the "study of behaviour of large collections of…simple, interacting units, endowed with the potential to evolve with time" (Coveney, 2003). While the entire theory is more complex than this, this definition is useful as it encompasses three fundamental characteristics of complex systems: they involve interacting units, are dynamic, and are adaptive.

In essence, complexity theory is about (1) the interaction dynamics amongst multiple, networked agents, and (2) how emergent events – such as creativity, learning, or adaptability – arise from these interactions (Marion, 2008). Over the past decade, a group of researchers have focused on reframing and advancing the field of leadership through the use of the complexity sciences.

Complexity leadership theory emerged in response to perceived limitations in existing leadership theory. Much leadership theory is based in a bureaucratic framework representational of the industrial age in which it was developed. This includes the assumption that goals are rationally conceived and that the achievement of these goals should be done through structured managerial practices. As a result, much of leadership theory focuses on how leaders, amidst formal and hierarchical organizational structures, can better influence others toward desired goals. The core issues within such a leadership paradigm have then become motivating workers regarding task objectives, ensuring their efficient and effective production, and inspiring their commitment and alignment to organizational objectives (Bass & Riggio, 2006; Zaccaro & Klimoski, 2001, as cited in Uhl-Bien, et al., 2007).

Fundamentally, there is a core drive toward top-down alignment and control in this model. The traditional bureaucratic mindset that has developed as a result of this paradigm has demonstrated limited effectiveness with the rise of the Knowledge Era and the complexities of the modern world (Lichtenstein, et al., 2006). The Knowledge Era is characterized by the forces of globalization, technology, deregulation and democratization collectively creating a new competitive landscape. In such an environment, learning and innovation are vital for competitive advantage (Halal & Taylor, 1999; Prusak, 1996, as cited in Uhl-Bien, et al., 2007), and control is arguably not possible or sustainable.

Complexity leadership is proposed as a framework for leadership in the fast-paced, volatile, and uncertain context of the Knowledge Era (Marion & Uhl-Bien, 2001). It is a needed upgrade to leadership theory to reflect our shift out of the Industrial Era (Uhl-Bien, et al., 2007).

Rather than focusing on top-down control and alignment, complexity leadership theorists argue that leaders should temper their attempts to control organizations and futures and instead focus on developing their ability to influence organizational behavior so as to increase the chances of productive futures (Marion & Uhl-Bien, 2001). The fundamental concept underlying complexity leadership is that, under conditions of knowledge production, informal network dynamics should be *enabled* – and not suppressed or aligned (Uhl-Bien, et al., 2007). Marion and Uhl-Bien (2001) contend that leadership success is not dependent upon the charisma, strategic insight, or individual power of any given leader. Rather, it is attributable to the capacity of the organization to be productive in mostly unknown, future states.

Leaders must therefore foster the conditions that develop that organizational capacity. They need to focus on understanding the patterns of complexity and manipulating the situations of complexity more than results. Specific recommendations are discussed below for how to do this. In a broad sense, though, leaders should create the conditions for bottom-up dynamics, leave the system essentially alone so that it can generate positive emergence, and provide some basic control to keep the system focused (i.e., broader goals and a vision) (Marion & Uhl-Bien, 2001).

Lewin and Regine (2003, as cited in Panzar, 2009) agree with this overall description of the new type of leadership required. For them, leaders need to move beyond setting an organizational vision and mobilizing around it. Successful long-term strategies are those that emerge from the continuous, complex interactions among people. As a result, leaders need to stop trying to control individual outcomes and instead shift their focus to the interactions with the intention to create the healthy conditions for people to self-organize around relevant issues. To do this requires leaders to change their perspective to see the organization as a complex adaptive system that unfolds, fluctuates, and emerges. This shifts a leader's attention from trying to direct people to serving the flourishing of dynamic interactions within the organization.

So what does all of this mean for our contemporary notions of leadership? The following section discusses some of the shifts and reframing in our concepts about leadership that occur once we put on a complexity lens.

Dispelling myths about leadership (Plowman & Duchon, 2008)

Through the lens of conventional leadership, the world is assumed to be knowable. Desired organizational or systemic futures are considered achievable through focused planning and the use of control mechanisms. Complexity scientists counter that uncertainty is a better starting point. Specifically, they contend that the world is not knowable, systems are not predictable, and living systems cannot be forced along a linear trajectory toward a predetermined future. There are four myths of conventional leadership that are therefore dispelled by the application of complexity sciences: leaders specify desired futures; leaders direct change; leaders eliminate disorder and the gap between intentions and reality; and leaders influence others to enact desired futures. The behaviors of complexity leadership – or emergent leadership – which replace these "myths" are summarized below.

Myth 1: Leaders specify desired futures. Conventional leadership worldviews frame leaders as visionaries, who see the future, chart the destination, and guide their organizations toward that destination. The repeated prescription is to: clarify the organization's desired future, scan the external environment, design the requisite actions, and remove any obstacles. Complexity theorists suggest that organizational unpredictability often comes from within the organization or system, through the interactions of its members, which are not controlled by its leader. It is usually these members that develop the ideas that lead to productive futures for the organization or system. They are arguably a more important source of ideas than the vision of a leader at the top of an organization. Therefore, complex leaders should focus on *enabling* productive futures rather than controlling them (Marion & Uhl-Bien, 2001). Thus, the "new reality" to replace Myth #1 is that "*leaders provide linkages to emergent structures by enhancing connections among organizational members*" (Plowman & Duchon, 2008, p. 139). This is based upon the complexity theory principle of emergent self-organization, in which the interaction of individual agents, exchange of information amongst them, and continuous adaptation of feedback from each other creates a new system level order.

Myth #2: Leaders direct change. Leadership theorists often contend that the essence of leadership is to lead change (e.g., Kotter, 1996). One of the principles of complexity theory concerns sensitivity to initial conditions. It notes that major, unpredictable consequences can arise out of small fluctuations in initial conditions (Kauffman, 1995). Thus small changes at anytime, anywhere in the system, can cascade and lead to massive change that may be inconsistent with the leader's change vision. The new reality to replace this myth, then, is that "*leaders try to make sense of patterns in small changes*" (Plowman & Duchon, 2008, p. 141). By detecting and labeling patterns in the midst of emergent change, leaders have a greater chance of helping organizations/systems to respond effectively.

Myth #3: Leaders eliminate disorder and the gap between intentions and reality. Leaders are typically seen as needing to influence others to accomplish the tasks required to achieve organizational or systemic objectives. They are also expected to minimize conflict and cultivate harmonious relationships, such as in the case of leader-member exchange (LMX) theory (Graen & Uhl-Bien, 1995). Complexity theorists contend that organizations/systems are not characterized by stability and harmony, but rather exist on a continuum between stability and instability (Prigogine, 1997; Stacey, 1996). As organizations/systems gravitate toward greater instability, due to destabilizing forces, new, emergent ideas and innovations arise. Therefore, rather than constantly attempting to stabilize an organization/system, leaders can at times help them to benefit by being a source of disorder and destabilization. The new reality to replace Myth #3 is therefore: "*leaders are destabilizers who encourage disequilibrium and disrupt existing patterns of behavior*" (Plowman & Duchon, 2008, p. 142).

Myth #4: Leaders influence others to enact desired futures. The core of leadership is often considered to be influence. Two assumptions about influence run counter to a principle of complexity science. First, influence is often based upon the assumption that a leader knows what needs to be done and that the leader can subsequently influence those who need it to bring about a desired future state. These notions are, in turn, grounded in assumptions of linearity: that changes in one variable lead to anticipated changes in another. Complexity science, though, is based upon nonlinear interactions, in which multiple agents with varying agendas engage and influence each other's actions. Nonlinear, living systems can learn, though. With such complexity and uncertainty within organizations/systems, is it impossible for leaders to know and prescribe to others what to do. Instead members of the organization or system often help leaders to find directions out of confusion and uncertainty. As such, the new reality to replace Myth #4 is: "*leaders encourage processes that enable emergent order*" (Lichtenstein & Plowman, 2009, p. 143). An example would be for a leader to focus on clarifying processes rather than clarifying outcomes, and allow the organizational members to determine the relevant outcomes.

Toward a Practice of Complexity Leadership

After my review of literature on complexity leadership, a representative set of practices emerged that reflect the field to date. These are not meant to be a comprehensive distillation of complexity leadership behaviors, but rather a sampling. For further details, see the books on the topic (Goldstein, et al., 2010; Hazy, et al., 2007; McMillan, 2008; Stacey, 2007, 2010; Stacey, et al., 2000; Uhl-Bien & Marion, 2008; Wheatley, 2006).

These core practices come from two sources. The first is Marion and Uhl-Bien's (2001) pioneering work in which they identify guidelines for leading in complex organizations. The second is Lichtenstein and Plowman's (2009) work to construct a complex systems leadership theory of emergence at successive organizational levels.

1. Guidelines for leading in complex organizations (Marion & Uhl-Bien, 2001)

Complex leadership is the process of fostering conditions in which the new behaviors and direction of the organization or system emerge through regular, dynamic interaction. Rather than trying to control or exactly direct what happens within the organization or system, they influence its behavior through the management of networks and interactions. The following five practices underlie the implementation of such leadership.

Foster network construction. Effective leaders learn to cultivate interdependencies through the management and development of networks within – and external to – their organization. This involves forging new connections where none exists, or enriching existing connections. The development of these networks provides contacts, but more importantly, they form the structure from which innovation can emerge. A strong network is a source of fitness for an organization or system, as it provides fitness to the technologies upon which it is based, as well as to the participating systems as well.

Catalyze bottom-up network construction. In addition to creating and maintaining networks, leaders also need to create the supportive environment in which new networks can emerge. By indirectly fostering network construction, they can catalyze network development. The ways to be such a catalyst range from delegation, resource allocation, and encouragement, to simply not interfering in network construction. Work environments can be reorganized to support interaction, additional decision-making powers and trust can be extended to their staff, and even new rituals and myths can be constructed that help create a culture of interaction and networking. Finally, complex leaders can also catalyze network development by avoiding solving problems for workers, insisting, rather, that they work out their own issues collaboratively.

Become leadership "tags." A tag is the flag around which all parties rally, the binding philosophy that brings people together. Leaders can catalyze network development by becoming a tag. This does not mean that they control people with respect to a certain philosophy, but rather that they represent the essence of that philosophy or concept. For example, a school principle might serve as a tag for institutional excellence and the school's reputation. These leaders rally people around the ideals of the organization, promoting an idea and an attitude.

Drop seeds of emergence. Complex leaders drop seeds of emergence by identifying, encouraging, empowering, and fostering connection between knowledge centers within an organization or system. Rather than trying to closely control, such leaders let people try new approaches, and pilot the application of novel ideas, then challenges them to evaluate and adjust their experiments. One way to do this is to send workers to conferences or other idea-generating environments in search of new insights and opportunities. The purpose here is to create a space of organized disorder that spawns dynamic activity, emergent behavior, and creative surprises at multiple locations throughout the system.

Think systemically. Systemic thinking (Senge, 1990) is central to complexity leadership. It challenges leaders to continually be aware of the interactive dynamics at multiple levels of engagement, from aggregate, through meta-aggregate, to meta-meta-aggregate levels. This is not an easy thing to do, but it is vital to consistently see the broader pattern of events and understand the network of events that have caused a problem.

2. The leadership of emergence (Lichtenstein & Plowman, 2009)

Lichtenstein and Plowman (2009) build upon the sets of behaviors discussed above(Marion & Uhl-Bien, 2001). Their focus is not on complexity leadership as a whole, but rather specifically on the production of newly emergent orders from the dynamic interactions between individuals.

A newly emergent order arises when the capacity of a system to achieve its goals increases profoundly, by several orders of magnitude. The researchers identified four conditions for such emergence: the presence of a dis-equilibrium state, amplifying actions,

recombination or "self-organization," and stabilizing feedback. These conditions can be generated, they contend, through nine specific leadership behaviors, which are briefly discussed below.

Disrupt existing patterns to generate dis-equilibrium. Two leadership behaviors contribute to this practice: embracing uncertainty and surfacing conflict to create controversy. Leaders and organizational members need to embrace the uncertainty they face in order to initiate or heighten the system's state of dis-equilibrium. By honestly assessing the situation, possible choices and uncertain outcomes, and not simply dictating solutions, leaders and members change the context in which they are operating, helping to destabilize the system.

Additionally, generating constructive conflict and creating controversy are also key to driving a move toward dis-equilibrium. This practice alters the conditions in which members function. In a space of such discomfort and conflict, new ideas, possibilities, and even structures tend to emerge.

Encourage novelty to amplify actions. Three behaviors serve to encourage novelty that in turn amplifies actions, helping small changes to cascade, escalate, and quickly move through the system. The first of these behaviors is to allow experiments and fluctuations. By letting seeds of potential change be dispersed widely and grow, leaders increase the chances that some will "take root" and spread rapidly through the system.

The second leadership behavior is to encourage rich interactions through a culture of "relational space." The non-linearity of complex adaptive systems can lead to rich and meaningful interactions that catalyze unexpected, positive outcomes. When done within a context of mutual trust, respect and psychological safety – a "relational space" – these rich interactions deepen the interpersonal connections amongst participants. This supports the amplification of changes as they occur.

The final leadership behavior is to support collective action. While certain individuals are responsible for key actions, often it is the collective action that creates the coherence and strength of an initiative, and allows for unexpected connections to arise. By allowing chaotic, collective action, leaders create the conditions for amplification of initial changes.

Sensemaking and sensegiving for recombination and self-organization. When systems are at their capacity limits, they either collapse or reorganize. As agents and resources in a system are recombined in new ways of interacting, system functioning tends to improve. By making and giving sense to issues within a complex adaptive system (through the following three behaviors), leaders support development of the conditions in which systems can recombine and self-organize.

The first leadership behavior is to create correlation through language and symbols. Correlation means a shared understanding of a system (Marion & Uhl-Bien, 2001). It can be created through specific, repeated language that reframes or gives additional meaning to a phenomenon, or via symbols that cultivate mutual understanding.

Secondly, leaders can work to recombine resources. By uniquely recombining space, capital, capabilities and other vital resources, emergence can be fostered. These novel combinations alter the context in which people are working and stimulate new connections.

Finally, leaders can accept "tags," as discussed above. When a single, or multiple, individuals accept becoming a "tag" for an emergence process, there is greater likelihood for "self-organization."

Stabilizing feedback. Once amplification of change has begun, it sometimes needs to be dampened so that the emergent change does not spin the system out of control. The key behavior the researchers identified to enable this condition is to integrate local constraints. This means to make adjustments to the system based upon localized needs, thereby helping the emergent change to better adapt to that specific context. An example would be changing the hours of new operations of an organization to better meet an important group of constituent's needs.

Conclusion

This document has attempted to distill some key concepts from a very deep and broad field. There are many subtleties not mentioned here, and I encourage interested readers to explore the cited literature and new literature on the topic.

Nonetheless, what's important regarding working with sustainability is to learn to put on a complexity lens periodically. Use it to inform your decision-making. For me, the key is to honor that I'm working with a complex adaptive system that is out of my control and won't move in a linear pattern (no matter how good my plans are). I strive to remember to look across the system for positive deviance that can be amplified. I like to probe and experiment frequently, and when possible I loosen control so that things can shift due to their own organic drives and dynamics. I prefer to

spend more time in "dialogue" with the system than trying to control it; learning about it and listening closely as I dance with it.

However, ultimately it is important to also be willing to put down the lens of complexity theory (and all other models) and just be present to what is arising within you, within the individuals involved, and within the system itself. Complexity theory is one of many conceptual models that have emerged to attempt to explain reality, each increasingly sophisticated and nuanced. Like the magical, mythical, rational/mechanistic, and systems models which have come before it, it will itself fall out of favor in the light of new understandings.

Consider even imagining yourself *as* the system, sensing into what it needs and wants next as part of its own development, and see what ideas arise. This is a practice of very conscious sustainability leaders that I have studied (Brown, 2012). Such intuitive and conceptual practices can often provide vastly useful information that would otherwise be blocked by using a lens like complexity theory to interpret the world.

In sum, I encourage you to heartily embrace complexity thinking as a tool for your toolkit to engage in sustainability. It truly has powerful potential as a way to understand and help craft responses to the wildly complex and ambiguous domains that are the nature of sustainability work. Yet always remember that it is also ultimately a filter that you are laying across the raw data of the moment – like any worldview or model – so hold it lightly and be willing to let it go.

About the Author

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References

Bak, P., & Tang, C. (1989). Self-organized criticality. *Physics Today, 42*(1), S27.

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership*. Mahwah, NJ: Lawrence Erlbaum Associates.

Brown, B. C. (2011). Complexity leadership: An overview and key limitations. *Integral Leadership Review, October*.

Brown, B. C. (2012). Conscious leadership for sustainability: How leaders with late-stage action logics design and engage in sustainability initiatives. [Ph.D. dissertation]. *Dissertation Abstracts International, 73*(07A), UMI No. 3498378.

Carley, K., & Hill, V. (2001). Structural change and learning within organizations. In A. Lomi & E. R. Larsen (Eds.), *Dynamics of organizational societies* (pp. 63-92). Cambridge, MA: AAAI/MIT Press.

Carley, K., & Lee, J. S. (1998). Dynamic organizations: Organizational adaptation in a changing environment. *Advances in strategic management: A research annual, 15*, 269-297.

Cilliers, P. (1998). *Complexity and postmodernism: Understanding complex systems*. London, UK: Routledge.

Coveney, P. (2003). *Self-organization and complexity: A new age for theory, computation and experiment*. Paper presented at the Nobel symposium on self-organization at Karolinska Institutet, Stockholm.

Goldstein, J. A., Hazy, J. K., & Lichtenstein, B. B. (2010). *Complexity and the nexus of leadership: Leveraging nonlinear science to create ecologies of innovation*. New York, NY: Palgrave Macmillan.

Goodwin, B. (1994). *How the leopard changed its spots: The evolution of complexity*. New York, NY: Charles Scribner's Sons.

Graen, G. B., & Uhl-Bien, M. (1995). Development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-domain perspective. *The Leadership Quarterly, 6*, 219-247.

Halal, W. E., & Taylor, K. B. (Eds.). (1999). *Twenty-first century economics: Perspectives of socioeconomics for a changing world*. New York, NY: Macmillan.

Hazy, J. K., Goldstein, J. A., & Lichtenstein, B. B. (2007). *Complex systems leadership theory: New perspectives from complexity science on social and organizational effectiveness*. Mansfield, MA: ISCE Pub.

Hëdstrom, P., & Swedberg, R. (1998). *Social mechanisms: An analytical approach to social theory*. Cambridge, UK: Cambridge University Press.

Holland, J. H. (1995). *Hidden order*. Reading, MA: Addison-Wesley.

Kan, C., & Bak, P. (1991). Self-organized criticality. *Scientific American, 264*(1), 46.

Kauffman, S. A. (1995). *At home in the universe: The search for laws of self-organization and complexity*. New York, NY: Oxford University Press.

Kotter, J. P. (1996). *Leading change*. Boston, MA: Harvard Business School Press.

Langston, C. G. (1986). Studying artificial life with cellular automata. *Physica, 22D*, 120-149.

Levy, S. (1992). *Artificial life: The quest for new creation*. New York, NY: Random House.

Lewin, R., & Regine, B. (2003). The core of adaptive organizations. In E. Mitleton-Kelly (Ed.), *Complex systems and evolutionary perspectives on organizations: The application of Complexity Theory to organizations* (pp. 167-184). London, UK: Pergamon.

Lichtenstein, B. B., & Plowman, D. (2009). The leadership of emergence: A complex systems leadership theory of emergence at successive organizational levels. *Leadership Quarterly, 20*(4), 617.

Lichtenstein, B. B., Uhl-Bien, M., Marion, R., Seers, A., Orton, J. D., & Schreiber, C. (2006). Complexity leadership theory: An interactive perspective on leading in complex adaptive systems. *Emergence: Complexity & Organization, 8*(4).

Marion, R. (1999). *The edge of organization: Chaos and complexity theories of formal social systems*. Thousand Oaks, CA: Sage.

Marion, R. (2008). Complexity theory for organization and organizational leadership. In M. Uhl-Bien & R. Marion (Eds.), *Complexity leadership, Part 1: Conceptual foundations* (pp. 1-15). Charlotte, NC: Information Age Publishing.

Marion, R., & Uhl-Bien, M. (2001). Leadership in complex organizations. *The Leadership Quarterly, 12*(4), 389.

McMillan, E. M. (2008). *Complexity, management and the dynamics of change: Challenges for practice*. New York, NY: Routledge.

Plowman, D. A., & Duchon, D. (2008). Dispelling the myths about leadership: From cybernetics to emergence. In M. Uhl-Bien & R. Marion (Eds.), *Complexity leadership, Part 1: Conceptual foundations* (pp. 129-154). Charlotte, NC: Information Age Publishing.

Prigogine, I. (1997). *The end of certainty: Time, chaos, and the new laws of nature*. New York, NY: Free Press.

Prusak, L. (1996). The knowledge advantage. *Strategy & Leadership, 24*, 6-8.

Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning organization*. New York, NY: Doubleday/Currency.

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review November*, 1-8.

Stacey, R. D. (1996). *Complexity and creativity in organizations*. San Francisco, CA: Berrett-Koehler.

Stacey, R. D. (2007). *Strategic management and organisational dynamics: The challenge of complexity* (5th ed.). Harlow, UK: Prentice Hall.

Stacey, R. D. (2010). *Complexity and organizational reality: Uncertainty and the need to rethink management after the collapse of investment capitalism*. New York, NY: Routledge.

Stacey, R. D., Griffm, D., & Shaw, P. (2000). *Complexity and management: Fad or radical challenge to systems thinking?* London, UK: Routledge.

Uhl-Bien, M., & Marion, R. (2009). Complexity leadership in bureaucratic forms of organizing: A meso model. *Leadership Quarterly, 20*(4), 631.

Uhl-Bien, M., & Marion, R. (Eds.). (2008). *Complexity leadership, Part 1: Conceptual foundations*. Charlotte, NC: Information Age Publishing.

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the Industrial Age to the Knoweldge Era. *The Leadership Quarterly, 18*(4).

Wheatley, M. J. (2006). *Leadership and the new science: Discovering order in a chaotic world*. San Francisco, CA: Berrett-Koehler.

Zaccaro, S. J., & Klimoski, R. J. (2001). The nature of organizational leadership: An introduction. In S. J. Zaccaro & R. J. Klimoski (Eds.), *The nature of organizational leadership* (pp. 3-41). San Francisco, CA: Jossey-Bass.