

Complexity and the Dynamics of Organizational Change

Glenda H. Eoyang

INTRODUCTION

Dramatic changes in organizational environments at the end of the twentieth century and continuing into the twenty-first have driven the need for new theories and tools to cope with organizational change. At the same time, developments in understanding of nonlinear dynamics, particularly from complexity science, provide an array of new ways to conceptualize and influence change in organizations. These new approaches have introduced descriptive and explanatory metaphors to inform practice and, as a result, some long-standing dichotomies that shaped understanding of and actions toward organizational change have been transformed into 'generative paradoxes'. In the next stages of research and practice related to organizational change, what is required is the development of theories and tools that can influence options for action through prospective application, translate into practice with both ease and insight, and consistently capture both the stability and disruption that are central to the complex dynamics associated with organizational change. This chapter reviews complexity-inspired perspectives on organizational change;

and proposes a practical approach for moving forward that bridges between control-oriented and emergence-oriented approaches to organizational dynamics.

APPROACH

This overview of the literature seeks to present a picture that is both wide and coherent, but undertaking it presented a variety of challenges and, inevitably, trade-offs. So it is important to be clear about the approach taken.

First, this chapter focuses primarily on research published in English that explicitly applies theories and language from complexity science. But it must be acknowledged that there are practitioners implementing complexity-inspired innovations and insights who have chosen not to publish about them; there are scholars doing excellent work in languages other than English; and both researchers and practitioners often allude to patterns of complex adaptive organizational change dynamics without using complexity language explicitly (March, 1981; Morgan, 1986; Larsen, 2002). Identity and its transformation

(Bouchikhi and Kimberly, 2003), large scale change events (Eggers et al., 2002; Bunker and Alban, 2006), portfolio theory (Donaldson, 2000), and turbulent environments (Head, 2005) are examples of ways in which 'common' language of change is used to describe unpredictable and complex phenomena without explicitly drawing from the concepts and principles of complex adaptive systems. In fact, for decades, scholars and practitioners have described what is now recognized as nonlinear dynamics of organizational change. 'Given the pace of events and the turbulent environment, organizations confront tremendous problems' and '[e]ssentially, this means that organizational systems must renew themselves continuously if they are to survive in this society' (Bennis, 1969: 7). Similarly, Weick (1979) described a massively entangled and dynamic world in which individual agents engaged to change each other and to form emergent systemic patterns over time. Certainly, reconciling studies in which a complexity perspective is implicit with those that explicitly draw on concepts from studies of complex systems represents an important research frontier but is, however, beyond the scope of this chapter.

Second, both the fields of complexity science and organizational change research are quite diverse, so a single, coherent view of either – to say nothing of both considered together – presents a daunting challenge. This chapter does not presume to create order out of what might be termed the chaos of the literatures – and the sheer variety of phenomena, methods, models, and tools in both literatures suggests that convergence will not come soon, if at all – but, rather, begins to articulate some of the patterns that are forming across the two fields.

Third, the literature is deeply, though not always explicitly, divided on the question of whether 'complexity' is an ontological or epistemological reality. Because excluding either of these perspectives constrains the usefulness of theory and tools for organizational change, this chapter adopts an approach that is based on the work of Habermas

(as discussed in Knorr-Cetina and Cicourel, 1981) in which intersubjective truth can emerge from truth claims that rest on objective (external evidence), subjective (personal perspective), and/or normative (group agreements) arguments and evidence. Essentially this is a pragmatic, practitioners' stance, based on the assumption that the purpose of work on organizational change is to facilitate change in organizations. Such a stance requires doses of both ontological and epistemological reality. The organization, as an object of action, must be assumed to exist, as it responds in demonstrable and unpredictable ways to action of individuals and groups. On the other hand, the organization's relevant characteristics at a particular point are determined by the perspectives, experiences, and world views of the engaged actors. This chapter explores this dichotomy and its relevance to complex organizational change, but an acknowledgement of the pragmatic stance helps to establish the assumptions on which this chapter is based.

Fourth, the nature of complex adaptive systems sometimes precludes traditional research approaches to theory building and testing where rigor of research is judged according to its validity and reliability, so these criteria have not been applied to filter articles presented. Organizations as complex adaptive systems are assumed and observed to be sensitive to initial conditions, path dependent on their histories, (frequently) high dimension, and (usually) open to external influences. As a result, it is unreasonable to expect any two situations to be similar enough to support validity or to be predictable enough over time to allow for reliability. New definitions of rigor and new methods of both positivistic and interpretive research are emerging to support innovative ways of seeing and documenting phenomena that are either local and particular or global and generalized (Vesterby, 2008). For this reason, no claims are made as to the boundaries of generalizability of the findings from the studies cited in this chapter, and the power of many of the findings will remain an empirical question.

Fifth and finally, the substance of nonlinear dynamics as applied to human activity can be understood and incorporated in four different ways: *practice*, *descriptive metaphors*, *explanatory metaphors*, and *mathematics* (Eoyang, 2004). Practice executes change in organizations; descriptive metaphors inform shared narratives and suggest reasonable options for action; explanatory metaphors invite qualitative analysis and support interpretive theory building, testing, and adaptive action; while mathematics provides a level of 'objective' rigor. This chapter includes examples of all of these approaches but does not presume to judge that any is superior or inferior to the others. All approaches to applications of complexity science bring certain benefits and risks in understanding and influencing organizational change. Responsible research and practice require that both purveyors and users of research are aware of where they stand on the continuum between superficial description and deep, causal understanding (Palmer and Dunford, 1996).

Because approaches emphasizing practice and mathematics are well handled in other chapters in this Handbook, this chapter focuses more on descriptive and explanatory metaphors. Descriptive use of complexity metaphors consists primarily of retrospective analysis of organizational change using visual metaphors from complexity science (Wheatley, 1992; Hock, 2005). Used to describe either the preconditions or the outcomes of change processes, descriptive metaphors label and categorize patterns, rather than describing how or why change happens. These organizational applications of the metaphors may be more or less sensitive to the nuances of the physical phenomena from which the metaphors were derived. Various critiques have been made of loose applications of complexity metaphors to organizational change (Fuller and Moran, 2000; Stacey et al., 2000; Smith, 2005; Paley, 2007), but some argue that rigid application of the language is not necessary for support of organizational theory and practice (Van Uden, 2005).

Explanatory metaphors, on the other hand, seek to articulate how the mechanisms of organizational change mimic the mechanisms of nonlinear change in physical or biological systems (Guastello, 1995; Lissack, 1999; Poole et al., 2000; Eoyang, 2001; Alaa, 2009). Explanations provide the ground for analysis and intentional action to influence change in complex adaptive systems. The mechanisms for complex change in biophysical systems involve subtle relationships and difficult mathematical concepts, so applications of explanatory metaphors to organizational change require a higher level of rigor and more profound disciplinary background than merely descriptive metaphors.

Adopting this approach, this chapter surveys the academic and practice literatures that explore and characterize ways in which organizational change theory and practice are being altered as a result of developments in complexity science.

FROM NEWTONIAN TO COMPLEXITY PERSPECTIVES

What has come to be called the traditional Newtonian view of change was grounded in features of the physical world. Time, mass, and distance were the fundamental units in which change of any kind could be described or explained. This worldview generated particular ways to characterize organizational change, built on particular understandings of key concepts. *Inertia* implied that the organization would not change unless acted upon by an outside force. *Resistance* implied that individuals and organizations would push back against efforts toward change. *Progress* implied that there was some pre-determined end toward which an organization could and should move. *Momentum* implied smooth and predictable paths of change. *Power* implied the ability to move an organization forward as if it were a passive object. *Alignment* implied a clear need for homogeneous commitment to a single goal. All of these and

many other physically grounded expectations were sufficient to describe and influence organizational change when organizations could be conceived as working in Newtonian contexts – relatively closed boundaries, small and consistent numbers of relevant factors, and linear causality. Various approaches and descriptions of organizational change reflect and/or critique these fundamental assumptions (Kelly and Amburgey, 1991; Tulloch, 1993; Tetenbaum, 1998; Knowles, 2001; Mason, 2004; Van Tonder, 2004).

Over the history of organization development and organization change practice and theory, various attempts have been made to explain the dynamic nature of change. Action research explored an understanding of how consultants, change agents, and organizational patterns interacted over time in complex ways. Organizational change was characterized as a process of unfreezing, moving, and refreezing. Various scholars and practitioners examined multiple phases of planned change. Processes were defined for client engagement over time. Others reframed the client engagement sequence to make it more dynamic and adaptive. Contingency theory strove to capture the cause and effect relationship between an organization's external environment and its internal structures and processes. In each of these developments, scholars used biological and physical metaphors from their contemporary science to describe the phenomena they observed in the course of organizational change.

At the end of the twentieth century, authors from around the world and across the economic and political spectra extolled the changing nature of change in human systems (Cleveland, 2000; Dawson et al., 2000; O'Hara-Devereaux, 2004; Friedman, 2007, 2008). Globalization opened traditional system boundaries. Emergent and unpredictable processes influenced many aspects of personal and organizational experience. Political unrest, religious fundamentalism, and antibiotic-resistant bacteria spread like wildfire. Technology increased the speed and reliability of communication. Economic and

political conditions encouraged mobility and resulted in massive increases in ethnic and cultural diversity. Product development and obsolescence cycles accelerated. Social networking and other Internet 2.0 tools emerged. Information was ubiquitous. Economic and lifestyle disparities expanded. The work force aged. Customers became more discerning and demanding. Everything that supported stability and continuity of organizations was compromised. Uncertainty increased. Organizational change became so unpredictable and uncontrollable that even the appearance of control became unsustainable. These conditions of radically open system boundaries, high dimension interaction, and nonlinear causality made the old metaphors of physical change insufficient to help people understand or influence change in this new organizational environment (Chaharbaghi and Nugent, 1994; Hodge and Coronado, 2007). Individuals and organizations needed new ways to think about, talk about, and interact to encourage organizational change.

The emerging nonlinear sciences of chaos and complexity have begun to provide these, offering new options for thinking and action toward organizational change (Lindberg et al., 1998; Michaels, 2001). Nonlinear dynamics focuses on change that may or may not involve Newtonian assumptions of absolute time, scale-dependent space, or physical mass. Prigogine and Stengers (1988) describe the role of irreversible time. Bak (1996) and others focus on scale-free phenomena in which physical size and its suggestion of space are completely relative. Organizational change deals with conceptual, relational, and cultural entities whose 'weight' cannot be measured with scales. Concepts and tools drawn from chaos theory, complexity science, and complex adaptive systems and other closely related branches of nonlinear dynamics have been used to describe organizational dynamics. As a result, traditional descriptors of organizational change are replaced with ones that better match the real-world phenomena of change in post-Newtonian organizations – butterfly effects, fractals, self-organized

criticality, emergent networks, attractor regimes, and so on (Eoyang, 1997). On the other hand, some applications of nonlinear dynamics to describe change in human systems have been critiqued as insufficient to explore the multi-faceted dynamics of organizational change (Dooley and Van de Ven, 1999).

In spite of concerns about the possible misapplication of metaphors from complexity science, the language has proven useful to respond to a variety of concerns. The necessity for a new organizational change paradigm (Falconer, 2002) has been met with responses that explicitly adopt a complexity perspective. Case studies have illustrated many of the dynamics of complexity in organizational change as well as some practical applications of complexity science metaphors and tools for understanding and influencing individual, procedural, and organizational change (Rowe and Hogarth, 2005) as well as the emergence of new organizational communities (Chiles, et al., 2004). New books that apply concepts and tools from complexity to various aspects of human systems continue to enter the market (Hudson, 2010).

This chapter explores three facets of this transformation of thinking and action for systems change. First, the most common complexity concepts are examined, as well as the ways in which those concepts have been used to explore, explain, and encourage organizational change through both practitioner and academic literature. Second, the changing worldview is examined by exploring how dichotomies of Newtonian change are converted into generative paradoxes in the world of complex, nonlinear change. Finally, possibilities for future exploration are suggested.

DESCRIPTIVE AND EXPLANATORY METAPHORS

Managing successful change requires an understanding of the current environment as well as a portfolio of descriptive and explanatory

models to inform action. The sheer diversity and contextual sensitivity of complex organizational systems requires that the practitioners have access to a wide range of theories and tools that might be applicable. Some research has compared and contrasted multiple organizational change models (Kilduff and Dougherty, 2000; Fernandez and Rainey, 2006). Others look broadly at applications of nonlinear dynamics to organizational change (Kiel, 1989; Goldstein, 1994; Dooley and Van de Ven, 1999; Zimmerman, 1999).

This section considers some of the most common metaphors inspired by complexity science and where and how they have been used in research and practice. As alluded to above, descriptive and explanatory metaphors draw language and models from complex adaptive systems and apply them to patterns in organizational change that seem to be similar in cause, outcome, or process. Some features of nonlinear dynamical systems (such as strange attractors) are more difficult than others (such as butterfly effects) to recognize, describe, and document through analogy or isomorphism to organizational change phenomena. This is because the phenomenon in the natural world is more complicated and subtle than implied in the metaphorical description. When the complexity descriptor is incorrectly or incompletely understood, then the metaphorical application to the organizational context will be flawed. Opinions differ widely on the appropriate use of even the most well reasoned complexity metaphors in describing organization change, still the metaphors continue to appear in both research and practitioner journals. Five explanatory and descriptive metaphors from complexity science have most often been alluded to in organizational change literature: fractals, simple rules, self-organized criticality, emergence, and adaptation.

Fractals

A fractal is a geometrical object that is generated by iteratively solving a nonlinear

equation and plotting the stability of the solution set for separate, individual initial starting points (Briggs and Peat, 1989). The resulting pattern is complex, coherent, and scale-free, which is to say that similar shapes appear regardless of how much the image is magnified. Fractals are used metaphorically in two ways when applied to organizational change.

First, the idea of the fractal has been used to represent a constant principle, rule, or idea that supports iterative applications and generates a complex but coherent system-wide image over time (Zimmerman and Hurst, 1993). For example, the concept of *identity* can be considered to be a ‘seed’ around which fractal patterns form (Bouchikhi and Kimberly, 2003). If all members of the group carry the same understanding of their own identity, then as they interact over time (internally and externally to the group), shared and coherent cultural and social patterns emerge. Spiritual traditions may function in a similar way, as they support complex interdependencies and influence system-wide coherent organizational change in complex systems. Examples of the fractal dynamics of spiritual traditions have included Confucianism (Tuan and Ryan, 2000) and mindfulness practice (Langer and Moldoveanu, 2000). In these situations, core principles are held by all practitioners and systemic patterns emerge at levels of family, group, institution, and community.

The other way that fractals are used metaphorically is to focus on the scale-free nature of the fractal pattern. This explicit metaphor of fractals can be applied to explore relationships within and across hierarchies, as well as the influence of individuals as they engage in organization change. For example, Levick and Kuhn (2007) explore how fractal patterns influence organizational management both during times of stability and of change. The metaphor of fractal patterns can also be used to diagnose and assess readiness for change when patterns of behavior are detected in all levels and all parts of an organization. Eoyang (1997) describes an approach for

using fractal images to support discussions that prepare individuals and organizations for change.

Simple rules

Simple rules, sometimes called minimum specifications, derive from applications of agent-based computer simulation models. In the computer applications, entities are programmed to respond to stimuli according to a short list of simple rules. As a result, they can self-structure into coherent, system-wide patterns (Wolfram, 2002). This metaphor has been applied to suggest ways to gain alignment during organizational change without over-constraining individual agents (Zimmerman et al., 2001; Kennedy, 2002; Eoyang, 2007). Holladay (2005) reports the use of simple rules to inform school reform, student learning, and reduced racial tensions in an urban school district. Despite these advances, it is important to note that simple rules have also been critiqued as inappropriate in describing self-organizing phenomena in human systems (Stacey, 2001; Paley, 2007; Snowden and Boone, 2007). Two arguments stand against use of simple rules in dealing with organizational change. The first involves free will: Rules do not constrain the actions of people. The second involves specificity: Rules that are general enough to apply to all are devoid of local or individual significance.

Self-organized criticality

Self-organized criticality refers to the way in which internal dynamics can result in unpredictable system-wide transformations. Bak (1996) used sand piles to simulate how accumulating tension at one level of scale can burst forth to reshape another level. The most familiar physical example is the avalanche, where the side of a mountain can appear to be stable and suddenly come crashing down. Gladwell (2002) popularized the notion as the ‘tipping point’, though his focus was simply

on a single point of transition, as opposed to the dynamical process leading up to and following after the critical point. Power law dynamics relate to the relative sizes and frequencies of system collapses under conditions of self-organized criticality. Sometimes referred to as 'punctuated equilibrium', discontinuous change related to self-organized criticality has been studied both with computer simulation models (Gersick, 1991; Sastry, 1997) and contemporary case studies (Romanelli and Tushman, 1994; Lichtenstein, 2000; Siggelkow, 2002) to explain the tendency of a complex system to absorb information and energy over time without apparent change, then to break through into a new structure with surprising speed and clarity.

When the self-organized criticality metaphor is applied to organizational change, it is usually used to characterize the relationship between continuous and discontinuous change. The question of continuous or episodic change has been a perpetual question in organization change theory (Anonymous, 1998). Inter-level influence and interdependency are central to the change through self-organized criticality. Organizational change theorists have explored the forces and phenomena of self-organized criticality (Dansereau et al., 1999; Burns and Nielsen, 2006). They have found that both the qualitative patterns of the process of self-organized criticality and the quantitative patterns of power law dynamics are relevant to retrospectively describe unpredictable, discontinuous, and cross-scale change in organizations.

Emergence

Emergence is widely regarded as the process by which a complex combination of agents generates system-level phenomena that are qualitatively different from the sum of the system's parts. This metaphor has been used widely and in a variety of contexts. Some case study research projects indicate that organizational patterns of behavior cannot be explained from the analysis of parts. Rather, they

emerge as systemic patterns from across a wide range of situations and stimuli (Bella, 1997; Hafsi, 2001). Other case studies have indicated that organizations adjust most effectively to change when situations are not over simplified and when individuals and teams are allowed to adjust to changes over time as patterns emerge and individuals and groups respond to the emergent patterns (Carroll and Hatakenaka, 2001).

Turbulent environments generate unplanned or 'emergent' behaviors, so they require more nimble, radical, fast, and disruptive responses. Often a capacity to respond to emergent events is acknowledged to support organic (rather than mechanical) and bottom-up (rather than top-down) change processes. While organic, emergent and mechanical, planned change can be contrasted, the two can also be seen as complementary. Often both are required to meet the needs of stability and innovation in situations of organizational change. A combination of both top-down (hierarchically imposed) and bottom-up (participatory) forces is most effective to leverage the power of complex organizational relationships as new patterns emerge over time (Huy and Mintzberg, 2003). Historical views of emergence in complex social structures at many levels can provide insights into the ways in which resource ownership and procurement influence emergence of organization and other social structures (Read, 2002). Emergence can also be used as a way to understand, explain, and intervene in the creative engagement associated with design processes. Standing between autonomous creativity implied by radical, *self-organizing* responses and highly constrained processes of 'designing for others', a mix of individual creativity and environmental sensitivity replaces the top-down/bottom-up challenge of design with and inside out/outside in models for organizational change (Rowland, 2004). Swarm intelligence is another emergence-inspired metaphor that is drawn from the biological world to describe self-organizing behaviors of human systems (Garnier et al., 2007).

Most applications of emergence in organizational change literature are descriptive in nature, but some have created explanatory metaphors by defining factors or conditions that influence self-organizing or emergent processes. Alaa (2009) articulated four factors that supported emergence in a software development project, including social constructions, adaptive factors, enabling infrastructure, and control factors. Eoyang (2001) describes three features that influence the speed, path, and coherence of emergent processes. Those three are related to each other in complex, nonlinear ways, and include the container, which holds the agents together; differences, which articulate the pattern and establish motivation for change; and exchanges, which support transfer of material and information among agents. Both of these explanatory models can be used retrospectively to analyze historical cases, or they can be used prospectively to inform action that encourages and influences organizational change.

Adaptation

Adaptation has arisen as one of the most frequently addressed aspects of complexity science in organizational change because it appeals to both common sense and technical understandings. Drawn from ecological and evolutionary theories of change, adaptation refers to the ways in which living organisms change their internal structures to enhance fit with the environment and improve possibilities of success. Along with its closely associated biological metaphor of evolution, adaptation is used as a way to consider many facets of organization change (Fulmer, 2000).

Evolution and evolutionary dynamics represent some of the earliest ways in which complex change in organizations was described (Hannan and Freeman, 1989; Finne, 1991; Baum and Singh, 1994; Knyazeva and Kurdyumov, 2001). Evolutionary adaptation toward fit with internal and external patterns is discussed in case studies (Siggelkow, 2002). One benefit derived from thinking about

organizational change as adaptation through evolutionary emergence is that a single causal structure can be relevant across levels of change – individual, organizational, cultural, and biological levels (Commons, 2008). The pace and direction of organizational change can be seen as driven by both internal and external factors, e.g. internal relationships can generate apparent resistance at the same time that evolutionary and revolutionary external changes occur. In practice, therefore, these two domains of change are part of the same evolutionary process (Miller and Friesen, 1980).

The concept of co-evolution, in which two entities adapt to each other over time, has also been applied to look at organization change in hypercompetitive environments (Rindova and Kotha, 2001). Specifically, it has been argued that engagement between and among team members, between teams in the same organization, and active competition among firms all increase the creative capacity in product development. More generally, when agents in a complex system adjust their internal characteristics to better fit with external agents to improve survival, their change processes can be characterized as ‘co-evolution’.

Adaptation is a familiar concept for scholars of organizational change, though it is not always used with the full range of nonlinear dynamical implications. A wide range of specific tools are used to address adaptive issues in organizational change. Various technical and management strategies have emerged to articulate the ways to resolve lack of fit between the demands of the marketplace and organizational policies, procedures, processes, and practices (e.g. Donaldson, 2000). Economic analysis theories distinguish among the abilities of various organizational types to respond to levels of uncertainty (e.g. Sorgaard, 1989). Employee turnover, for example, has been explored as one mechanism that drives disruption and adaptation in organizational change (Baron et al., 2001). Each of these approaches to adaptation and organizational change unveils

a different facet of the complex process of change in organizations. A qualitative concept of 'adaptation' is familiar outside of the complexity literature, but complexity science can provide a more precise definition that supports both practical application and rigorous research of this unpredictable process of organizational change.

In addition to considering the organization-wide implications of adaptation, some research has focused on how individuals adapt to influence organizational change. In these contexts, difference becomes a driving force for change. Individual and group identity and the need to adapt in order to resolve differences between the one with the other has been shown to be a critical factor in organizational change (Seo and Creed, 2002; Snowden, 2002; Kuhn and Corman, 2003; McCarthy et al., 2005; Beech et al., 2008). Dialectical engagement can be considered a mechanism by which entities resolve differences to adapt or co-evolve. Differences between self and other, individual and organization can be seen as forces that motivate and actuate organizational change (Myeong-Gu and Creed, 2002). Dissonance between context and organizational action (Greenwood and Hinings, 1996), self and other (Durand and Calori, 2006), production processes and communication structures (Sandaker, 2009), cultures in mergers (Baskin et al., 2000; Zimmerman and Dooley, 2001; Mitleton-Kelly, 2006), and logics of action (Bacharach et al., 1996) are used to explain the mechanisms and motivations for organizational change and adaptation over time. Complexity science provides metaphors and tools to explore creative tensions, high dimension differences, dynamic response to demands for fit, and multi-level relationships, so it can support a more rigorous and nuanced approach to understand difference and its impact on organizational change.

Stacey (2001) focuses on the interactions among individuals in a complex environment as the cause for radical innovation and emergent adaptation. Challenging the power of systems and systemic thinking, he posits that

complex responsive processes are at the core of individual and collective action that drives organizational change.

The need to adapt in times of turbulent change is pretty obvious, but the capacity to adapt to the right things at the right speed while maintaining organizational stability is not so clear. The tension between sustaining identity and adapting to improve fit among individuals or with organizations is an issue in many cases where adaptation might be considered a winning strategy (Cilliers, 2006; Glor, 2007). This problem of competing demands for stability and change also influences approaches to innovation. As a special case of adaptation, innovation also demands continuity coupled with radical change (Hage, 1999; Jarratt, 1999; Rycroft and Kash, 1999; Suchman, 2001; Kash and Rycroft, 2003). Complexity science provides theory and tools to formalize research and practice in these situations of unpredictable and uncontrollable organizational change.

Each of these five metaphors drawn from complexity science can be evocative for persons who study or influence organizational change. However, they are defined and applied in rather idiosyncratic ways so that a coherent, broadly accepted collection of key metaphors has not yet emerged in the field. Continued conversation among scholars and practitioners will be necessary before a coherent, shared understanding of complex organizational change will emerge.

FROM DICHOTOMIES TO PARADOXES

The current literature on organizational change as complex adaptation is rich in its diversity, but limited in its coherence. One possible resolution of the current cacophony is that a single view of complexity and its meaning for organizational change could emerge as a dominant set of theories and tools. Though efficient, this outcome would limit the flexibility and applicability of these theories and tools in the world of organizational change,

which is itself quite diverse. Another resolution would be to continue the anarchy of the past, while each practitioner and researcher follows an idiosyncratic argument from theory and practice of the past into theory and practice of the future. In the interest of coherence, however, a complex adaptive alternative might be considered – one in which the key dichotomies of the past are recast as establishing creative tension, to provide some level of bounded instability in which new theory and practice can continue to emerge. Eight creative tensions emerged across the articles reviewed for this chapter. With a Newtonian perspective on organizational change, these appeared as dichotomies that demanded a choice between the one and the other. From the complexity perspective introduced here, each pair can be seen as forming a generative relationship that will provide a map of the territory for complex organizational change theory and practice. Each of the complementary pairs is described below, and options for action in research and practice are suggested.

Explicit and implicit use of complexity concepts

One on-going question in applications of complexity to organizational change involves the language that is used to introduce the concepts and actions. As described above, the literature includes references to complex dynamics without explicitly invoking the language of complexity science. Sometimes, the concepts are made explicit intentionally (Webb et al., 2006), other times the nonlinear dynamics are not discussed at all, or they are renamed in language that is more familiar or comfortable. Implicit reference to the complex dynamics builds a bridge to traditional theory and to clients' practice worlds. Explicit complexity language provides opportunities to build and test a mature formalism of language and method. As applications of complexity to organizational change evolve, neither of these extremes will serve the field well.

Rather, complexity-inspired vocabularies should be used consciously, and scholars as well as practitioners should assume a critical stance regarding the use of both qualitative and quantitative complexity metaphors.

Change and stability

In complex systems characterized by emergence, a tension arises between the stability necessary to sustain identity and the change required for adaptation. Cross-level relationships can be used to understand and intervene to maintain this tension in a productive balance (Leana and Barry, 2000). While Stacey (2001) explains the mechanisms of transformation strictly through complex responsive processes, fractal patterns and the structural meta-stability of self-organized criticality speak to the simultaneous need for order and emergence. Scholars, practitioners, scholar-practitioners, and practitioner-scholars need to acknowledge that sustainable organizational change requires both stability and flexibility, both continuity and disruption, both ties to the old and stretches to the new. If complexity-inspired research and practice lose either of these dynamical forces, they will risk falling into Newtonian stasis or flying off into theoretical and practical anarchy.

Positivistic and interpretive research

Traditionally, a researcher had to choose one or the other: (typically but not necessarily quantitative) positivism or (typically but not necessarily qualitative) interpretation. The underlying ontologies and epistemologies are sometimes so radically different that no theory or tool could embrace both. Fortunately (or unfortunately, depending on your stance), this either/or approach to research is not useful in the context of complex systems. Depending on the circumstances, some facets of a situation can and should be bounded and measured while other facets will enfold such

high dimension, unique, and unpredictable phenomena that measurable indicators are meaningless. Neither approach is better or worse in any absolute way, but both can be badly abused if they are not fit to the environment and the research questions to be explored. The use of mixed methods and the choice to stay in generative engagement with diverse colleagues will allow the field to transcend this dichotomy.

Individual and organizational change

Traditional theories of change often forced change agents and researchers to focus on only one level of the change process: individual or organization. Complexity science opens a new path in which system-wide patterns of the whole emerge from semi-autonomous activities of the parts at all levels. Many outstanding questions remain about this connection between individual and collective change, but the metaphors and tools of complexity provide opportunities to articulate and address those questions in ways that were not possible before. This distinction is particularly clear in explorations of adaptation, where individual learning and change inform and are informed by evolution of organizational policy, procedures, practice, and identity.

Episodic and continuous change

Many researchers and practitioners used to ask whether organizational change was episodic or continuous. From a Newtonian point of view, this is a critical question, but from a complexity point of view it is not. Given the dynamics of scale-free patterns and self-organized criticality, it becomes obvious that organizational change is both. Continuous, incremental change can persist in some parts or at some organizational levels while episodic, catastrophic change occurs in others. Our theories and practices for organizational

change must account for both to happen simultaneously. Even more, they must account for the interdependencies between the two.

Retrospective and prospective analyses of change

For many years, complexity scholars were focused on retrospective analysis. Nonlinear dynamics were only observed in the rear view mirror, so research focused on case studies and deconstructing previous theory and practice. As a developmental stage, that was not a bad thing, but if complexity approaches are to be more than interesting fads, they must add value to decision making and action through prospective analysis as well. Research and practice should innovate and test methods for understanding and influencing current complex patterns to generate patterns of the future. This approach will involve explicit testing of theories that are used to anticipate outcomes and evaluate performance against them over time. Otherwise, applications of complexity science to organizational change will become merely historical reflections of nonlinear dynamics in human systems, not contributions to adaptive capacity for individuals and organizations.

Complexity as an epistemological and ontological phenomenon

Philosophers and physical and social scientists have been preoccupied with this dichotomy for decades if not centuries. Two factors entice us to move beyond this distinction and into a new way of thinking of ourselves as investigators in the world. First, complex adaptive systems worldview assumes a backdrop of reality that can be continually transforming. The pace and complexity of the ever-changing context precludes the opportunity to separate what is happening from my ability to know what is happening. According to some threads of quantum physics, humans

may even create physical reality with our thinking. Second, neither scholars nor practitioners have time to divorce themselves from innovative and meaningful action. At the point of action and receiving feedback to our action, the boundary between ontology and epistemology becomes a thin veil. When practitioners (or their clients) are in adaptive engagement with a complex environment, thinking and real-world causality merge. Certainly, one lesson that has been learned by viewing organizations as complex adaptive systems is that active engagement in the moment is the means to emergence and adaptation for survival.

Knowledge for theory and for practice

The journal *Emergence: Complexity and Organization* has wisely brought together scholars and practitioners to share their findings about complexity and human systems. As a result every reader is invited into a world of praxis, where theory is practice-informed and practice is theory-informed. The radical uncertainty, contextuality, and immaturity of this work mean that neither practice nor theory can stand alone in any coherent or meaningful way. As inquirers in this field, each of us must concern ourselves with both sides of this traditional dichotomy.

LOOKING FORWARD

As students of complex change work within the creative tensions of these traditional dichotomies, they will continue to frame and pursue questions about the dynamics of organizational change. Sometimes those questions will emerge in the midst of action for leaders or consultants, and sometimes those questions will emerge in the midst of theory building or testing. As the field moves forward to establish a stronger foundation of theory and practice, scholars will address a variety of questions, including the following.

What practical theories and tools can help individuals and organizations to be most productive in times of rapid change in complex environments? Complex change will require a different kind of change-supporting tool than simple, linear change. A single developmental cycle, a list of goals, a set of best practices will have limited usefulness because of the complex diversity of nonlinear change. On the other hand, the possibility lies open for tools that assess current patterns and look toward future possibilities, that encourage reflective praxis, and that embed well-grounded complexity science metaphors in productive action.

Some of the field's more practical researchers are engineering new tools and methods and making them available (Olson and Eoyang, 2001; Zimmerman et al., 2001), but the cycle time for development and dissemination is long. More people in more places need to be sharing their innovative products with others through peer reviewed journals, conferences, and web communications.

What vocabulary is appropriate for scholars and practitioners to see, describe, and influence the dynamics of organizational change, and how can it be developed? Such a common language will support both theory and practice as researchers, practitioners, and consumers share their perspectives, discoveries, and frustrations. It will help individuals and groups to be conscious when choosing implicit or explicit references to complex change. Falconer (2002) begins that process by encouraging a systemic view of complex adaptive change. Eoyang's (2001) Container, Difference, Exchange (CDE) Model and Ng's (2003) Strength-Power-Diversity (S-P-D) Model provide options that enfold the multiple dimensions of complex dynamics into simple, elegant, actionable, explanatory metaphors.

CONCLUSION

This chapter explored applications of complexity science to organizational change.

There was a time not too many years ago when chaos, complexity, and complex adaptive systems were foreign to both researchers and practitioners. Today, not only are these terms getting wide-spread acceptance, but the dynamical nature of organizational change is widely acknowledged. The challenge now is to use emerging insights about complexity science to accelerate theory development and to inspire practical innovation.

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