Chapter 8
Complexity Leadership Theory: Shifting Leadership from the Industrial Age to the Knowledge Era

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> As we advance deeper in the knowledge economy, the basic assumptions underlining much of what is taught and practiced in the name of management are hopelessly out of date... Most of our assumptions about business, technology and organization are at least 50 years old. They have outlived their time. (Drucker, 1998, p. 162)

> We're in a knowledge economy, but our managerial and governance systems are stuck in the Industrial Era. It's time for a whole new model. (Manville and Ober, 2003, Jan., p. 48)

According to Hitt (1998), "we are on the precipice of an epoch," in the midst of a new economic age, in which twenty-first century organizations are facing a complex competitive landscape driven largely by globalization and the technological revolution. This new age is about an economy where knowledge is a core commodity and the rapid production of knowledge and innovation is critical to organizational survival (Bettis and Hitt, 1995; Boisot, 1998). Consistent with these changes, much discussion is taking place in the management literature regarding challenges facing organizations in a transitioning world (Barkema et al., 2002; Bettis and Hitt, 1995; Child and McGrath, 2001).

Yet, despite the fact that leadership is a core factor in whether organizations meet these challenges, we find little explicit discussion of leadership models for the Knowledge Era. As noted by Davenport (2001), while it has become clear that the old model of leadership was formed to deal with a very different set of circumstances and is therefore of questionable relevance to the contemporary work environment, no clear alternative has come along to take its place. Osborn et al. (2002) argue that "a radical change in perspective" about leadership is necessary to go beyond traditionally accepted views, because "... the context in which leaders operate is both radically different and diverse. The world of traditional bureaucracy exists but it is only one of many contexts" (p. 798).

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We begin to address this shortcoming by developing a framework for leadership in the fast-paced, volatile context of the Knowledge Era (Marion and Uhl-Bien, 2001; Schneider and Somers, 2006). Our model extends beyond bureaucracy premises by drawing from complexity science, the "study of the behaviour of large collections of… simple, interacting units, endowed with the potential to evolve with time" (Coveney, 2003, p. 1058). Using the concept of complex adaptive systems (CAS), we propose that leadership should be seen not only as position and authority but also as a *complex interactive dynamic – a network-based process in which a collective impetus for action and change emerges when heterogeneous agents interact in ways that produce new patterns of behavior or new modes of operating* (cf., Heifetz, 1994; Heifetz and Linsky, 2002; Parks, 2005).

Complex adaptive systems (CAS) are a basic unit of analysis in complexity science. CAS are neural-like networks of interacting, interdependent agents who are bonded in a cooperative dynamic by common goal, outlook, need, etc. They are changeable structures that emerge at multiple, overlapping hierarchies within interactive, interdependent networks of agents. Like the individuals that comprise them, they are linked with one another in a dynamic, interactive network. Hedlund (1994) describes a generally similar structure relative to managing knowledge flows in organizations that he called "*temporary constellations* of people and units" (p. 82). CAS emerge naturally in social systems (Homans, 1950; Roy, 1954). They are capable of solving problems creatively and are able to learn and adapt quickly (Carley and Hill, 2001; Carley and Lee, 1998; Goodwin, 1994; Levy, 1992).

The leadership framework we propose, which we call Complexity Leadership Theory, seeks to take advantage of the dynamic capabilities of CAS. The goal of Complexity Leadership Theory (CLT) is to explore strategies for fostering organizational and sub-unit creativity, learning, and adaptability by enabling appropriate CAS dynamics within contexts of hierarchical coordination. In CLT, leadership has two broad functions: it *structures* and *enables* conditions such that CAS are able to optimally address creative problem solving, adaptability, and learning (referring to what we will call, administrative and enabling leadership); and it is a *generative dynamic* that underlies emergent change activities (what we will call, adaptive leadership).

This leadership perspective is premised on several critical notions. First, the informal dynamic we describe is embedded in context (Hunt, 1999; Osborn et al., 2002). Context in complex adaptive systems is not an antecedent, mediator, or moderator variable; rather, it is the fabric of interactions among agents (people, ideas, etc.), hierarchical divisions, organizations, and environments. CAS and leadership are socially constructed in and from this context – a context in which patterns over time must be considered and where history matters (Cilliers, 1998; Dooley, 1996; Hosking, 1988; Osborn et al., 2002).

Second, a complexity leadership perspective requires that we distinguish between *leadership* and *leaders.* Complexity leadership is a complex interactive dynamic that is productive of adaptive outcomes (for discussion of adaptive outcomes see Heifetz,

1994), and leaders are individuals who act in ways that influence this dynamic and the outcomes. Leadership theory has largely focused on *leaders* – the actions of individuals. It has not examined the dynamic, complex systems and processes that comprise *leadership*. Because of this, earlier models have been criticized for being incomplete and impractical (Gronn, 1999; Osborn et al., 2002; see also Hunt, 1999). Rost (1991) refers to this as the problem of focusing on the "periphery" and "content" of leadership with disregard for the essential nature of what leadership is – a *process* (cf., Hunt, 1999; Mackenzie, 2006).

Third, complexity leadership perspectives help us to distinguish leadership from managerial positions or "offices" (a bureaucratic notion, see Heckscher, 1994). The vast majority of leadership research has studied leadership in formal, most often managerial, roles (Bedeian and Hunt, 2006; Rost, 1991) and has not adequately addressed leadership that occurs throughout the organization (Schneider, 2002). To address this, we will use the term *administrative leadership* to refer to formal acts that serve to coordinate and structure organizational activities, and introduce the concept of *adaptive leadership* to refer to the leadership that occurs in informal dynamics throughout the organization (cf., Heifetz, 1994; Heifetz and Linsky, 2002).

Finally, complexity leadership occurs in the face of adaptive challenges (typical of the Knowledge Era) rather than technical problems (more characteristic of the Industrial Age). As defined by Heifetz (1994; Heifetz and Laurie, 2001), adaptive challenges are problems that require new learning, innovation, and new patterns of behavior. They are different from technical problems, which can be solved with knowledge and procedures already in hand (Parks, 2005). Adaptive challenges are not amenable to authoritative fiat or standard operating procedures, but rather require exploration, new discoveries, and adjustments. Day (2000) refers to this as the difference between management and leadership development. Management development involves the application of proven solutions to known problems, whereas leadership development refers to situations in which groups need to learn their way out of problems that could not have been predicted (e.g., disintegration of traditional organizational structures).

In the sections below we lay out the dynamics we call Complexity Leadership Theory. This framework describes how to enable the learning, creative, and adaptive capacity of complex adaptive systems (CAS) within a context of knowledge producing organizations. Complexity Leadership Theory seeks to foster CAS dynamics while at the same time enabling control structures for coordinating formal organizations and producing outcomes appropriate to the vision and mission of the organization. We begin by describing the leadership requirements of the Knowledge Era and the limitations of current leadership theory for meeting these requirements. We then describe why CAS dynamics are well suited for the needs of the Knowledge Era, and how leadership can work to enable these dynamics. We conclude with a presentation of the Complexity Leadership Theory framework and a description of the three key leadership functions and roles that comprise this framework: adaptive leadership, enabling leadership, and administrative leadership.

Leadership in the Knowledge Era

The Knowledge Era is characterized by a new competitive landscape driven by globalization, technology, deregulation, and democratization (Halal and Taylor, 1999). Many firms deal with this new landscape by allying horizontally and vertically in "constellations" (Bamford et al., 2002). In the process, they actively interconnect the world, creating what some have called a "*connectionist era*" (Halal, 1998; Miles, 1998). Through multinational alliances, firms in developing countries now find themselves engaging increasingly in manufacturing activities as producers or subcontractors, while firms in developed economies focus more on information and services (Drucker, 1999). The latter face the need to exhibit speed, flexibility, and adaptability, with the organization's absolute rate of learning and innovation and the pace of its development becoming critical to competitive advantage (Eisenhardt, 1989; Jennings and Haughton, 2000; Prusak, 1996). In other words, firms in developed economies sustain superior performance in the Knowledge Era by promoting faster learning (Child and McGrath, 2001).

This new age creates new kinds of challenges for organizations and their leaders (Barkema et al., 2002; Schneider, 2002). In this post-industrial era, the success of a corporation lies more in its social assets – its corporate IQ and learning capacity – than in its physical assets (McKelvey, 2001; Quinn et al., 2002; Zohar, 1997). In the industrial economy, the challenge inside the firm was to coordinate the physical assets produced by employees. This was mainly a problem of optimizing the production and physical flow of products (Boisot, 1998; Schneider, 2002). In the new economy, the challenge is to create an environment in which knowledge accumulates and is shared at a low cost. The goal is to cultivate, protect, and use difficult to imitate knowledge assets as compared to pure commodity-instigated production (Nonaka and Nishiguchi, 2001). It is a problem of enabling intellectual assets through distributed intelligence and cellular networks (Miles et al., 1999) rather than relying on the limited intelligence of a few brains at the top (Heckscher, 1994; McKelvey, 2008). Moreover, the focus is on speed and adaptability (Schilling and Steensma, 2001). Rather than leading for efficiency and control, appropriate to manufacturing (Jones, 2000), organizations find themselves leading for adaptability, knowledge and learning (Achtenhagen et al., 2003; Volberda, 1996).

To achieve fitness in such a context, complexity science suggests that organizations must increase their complexity to the level of the environment rather than trying to simplify and rationalize their structures. Ashby (1960) refers to this as the law of requisite variety; McKelvey and Boisot (2003) customized this law for complexity theory and call it the *Law of Requisite Complexity*. This law states simply that it takes complexity to defeat complexity – a system must possess complexity equal to that of its environment in order to function effectively. Requisite complexity enhances a system's capacity to search for solutions to challenges and to innovate because it releases the capacity of a neural network of agents in pursuit of such optimization. That is, it optimizes a system's capacity for learning, creativity, and adaptability.

As Cilliers (2001) observed, traditional approaches to organization have done the opposite: they have sought to simplify or to rationalize the pursuit of adaptation.

He argues that simplifying and rationalizing strategies lead to structures that define fixed boundaries, compartmentalized organizational responses, and simplified coordination and communication (e.g., Simon, 1962). However, such approaches are limited because they do not represent reality – boundaries are not fixed perimeters, but rather, are sets of functions that dynamically interpenetrate one another (Cilliers, 2001). To meet the needs of requisite complexity, Knowledge Era leadership requires a change in thinking away from individual, controlling views, and toward views of organizations as complex adaptive systems that enable continuous creation and capture of knowledge. In short, knowledge development, adaptability, and innovation are optimally enabled by organizations that are complexly adaptive (possessing requisite complexity).

Limitations of Current Leadership Theory

Despite the needs of the Knowledge Era, much of leadership theory remains largely grounded in a bureaucratic framework more appropriate for the Industrial Age (Gronn, 1999). One such element of the bureaucratic concept is the traditional assumption that control must be rationalized. Much of leadership theory is developed around the idea that goals are rationally conceived and that managerial practices should be structured to achieve those goals. As Chester Barnard (1938) framed it, the role of leadership is to align individual preferences with rational organizational goals. Philip Selznick (1948) observed that irrational social forces tend to subvert the formal goals of an institution.

Consistent with this, the dominant paradigm in leadership theory focuses on how leaders can influence others toward desired objectives within frameworks of formal hierarchical organizational structures (Zaccaro and Klimoski, 2001). This paradigmatic model centers on issues such as motivating workers toward task objectives (House and Mitchell, 1974), leading them to produce efficiently and effectively (Zaccaro and Klimoski, 2001) and inspiring them to align with and commit to organizational goals (Bass, 1985). Macro-level theories, such as those that address "upper-echelon leadership," are further premised in bureaucratic notions (Heckscher, 1994) that likewise mute uncontrolled behaviors; other models advocate a charismatic, visionary approach that is said to cascade down from the CEO to lower levels (Conger, 1999; Yukl, 2005). Leadership research has explored the implementation of these top-down organizational forms by drilling deeper and deeper into human relations models (aimed at alignment and control; Gronn, 1999; Huxham and Vangen, 2000).

Without realizing it, the inability to move beyond formal leaders and control inherent in traditional bureaucratic mindsets (Heckscher, 1994) limits the applicability of mainstream leadership theories for the Knowledge Era (Stacey et al., 2000; Streatfield, 2001). There seems to be a contradiction between the needs of the Knowledge Era and the reality of centralized power (Child and McGrath, 2001) that leadership theory has not yet addressed. "The dominant paradigms in organizational theory are based on stability seeking and uncertainty avoidance through

organizational structure and processes. . .. We believe that those paradigms are inadequate for global, hyper-competitive environments, although their replacements are not clear yet" (Ilinitch et al., 1996, p. 217). As noted by Child and McGrath (2001), "Scholars, managers, and others face a widespread challenge to bureaucracy's central benefit, namely, its utility as a vehicle for strong economic performance in the new era" (p. 1136). Leadership scholars face the same challenge:

> The. . . challenge is to identify alternatives [to bureaucracy] and develop theories that account for them. It is not trivial. How can we improve upon, even replace, such a painstakingly well-developed concept of how human beings collectively best accomplish their objectives? (Child and McGrath, 2001, p. 1136)

We address this challenge by developing a model of leadership grounded not in bureaucracy, but in complexity. This model focuses on leadership in contexts of dynamically changing networks of informally interacting agents. As will be elaborated below, the premise of complexity leadership is simple: Under conditions of knowledge production, managers should *enable*, rather than suppress or align, informal network dynamics. Early researchers, such as Lewin (1952) and Homans (1950), glimpsed the potential of such informal dynamics (however vaguely, by complexity theory standards); but the thrust of many follow-up studies of their findings assumed that such informal dynamics were problematic for achieving organizational goals (Roy, 1954; Selznick, 1957). Several recent initiatives have explored the potential of decentralized authority or leadership, including Pearce and Conger's work with shared leadership (Pearce and Conger, 2003), Gronn's work on distributed leadership (Gronn, 2002) and Fletcher (2004) and Volberda (1996) on flexible forms. None, however, have developed a model that addresses the nature of leadership for enabling network dynamics, one whose epistemology is consistent with *connective*, *distributed*, *dynamic*, and *contextual* views of leadership.

We propose such a model in this article, one that we call, Complexity Leadership Theory. This new perspective is grounded in a core proposition: *Much of leadership thinking has failed to recognize that leadership is not merely the influential act of an individual or individuals but rather is embedded in a complex interplay of numerous interacting forces.*

There are several orienting assumptions that underlie the complexity leadership model; these assumptions will be developed further in this article:

- Complexity Leadership Theory (CLT) is necessarily enmeshed within a superstructure of planning, organizing, and missions. CLT seeks to understand how that administrative superstructure can function to both coordinate complex dynamics and enhance the overall flexibility of their organizations (Marion and Uhl-Bien, 2007).
- Complexity Leadership Theory presumes hierarchical structuring and differing adaptive functions across levels of the hierarchy.
- The unit of analysis for Complexity Leadership Theory is the CAS. The boundaries of CAS are variously defined depending on the intent of the researcher, but however identified, they are, without exception, open systems.
- Leadership, however it is defined, only exists in, and is a function of, interaction.

Before we elaborate these ideas in our framework below, however, we first must understand why complex adaptive systems are well suited for the Knowledge Era and the dynamics that drive these systems. Therefore, we turn next to an overview of CAS dynamics that will serve as a basis for discussion in subsequent sections.

The Argument for Complexity Leadership Theory: CAS Dynamics

Earlier we defined complex adaptive systems (or CAS) as open, evolutionary aggregates whose components (or *agents*) are dynamically interrelated and who are cooperatively bonded by common purpose or outlook. We also introduced Complexity Leadership Theory as a model for leadership in and of complex adaptive systems (CAS) in knowledge-producing organizations. We now ask, "What is so unique about complex adaptive systems theory that it fosters a fresh look at leadership?" and "Why would we want to enable CAS dynamics anyway?"

To answer these questions we need to better understand the structure of CAS and how they are different from systems perspectives offered previously in the organizational literature. As described by Cilliers (1998), complex adaptive systems are different from systems that are merely complicated. If a system can be described in terms of its individual constituents (even if there are a huge number of constituents), it is merely *complicated*; if the interactions among the constituents of the system, and the interaction between the system and its environment, are of such a nature that the system as a whole cannot be fully understood simply by analyzing its components, it is *complex* (for example, a jumbo jet is *complicated*, but mayonnaise is *complex,* Cilliers, 1998).

Dooley (1996) describes a CAS as an aggregate of agents that "behaves/evolves according to three key principles: order is emergent as opposed to predetermined, the system's history is irreversible, and the system's future is often unpredictable." In CAS, agents, events, and ideas bump into each other in somewhat random fashion, and change emerges from this dynamic interactive process. Because of this randomness, and the fact that complex dynamics can exhibit sensitivity to small perturbations (Lorenz, 1993), CAS are rather organic and unpredictable (Marion and Uhl-Bien, 2001). Change in complex adaptive systems occur nonlinearly and in unexpected places, and, as Dooley (1996) observed, their history cannot be revisited (one cannot return a system to a previous state and rerun its trajectory).

Complexity science has identified a number of dynamics that characterize the formation and behaviors of CAS. For example, complexity science has found that interactive, adaptive agents tend to bond in that they adapt to one another's preferences and worldviews (Marion and Uhl-Bien, 2001). From this, they form aggregates (i.e., clusters of interacting agents engaged in some measure of cooperative behavior). Mature social systems are comprised of a complex of hierarchically embedded, overlapping and interdependent aggregates, or CAS (Kauffman, 1993).

Complexity science has also found that the behaviors of interactive, interdependent agents and CAS are productive of *emergent creativity and learning*. Emergence

refers to a nonlinear suddenness that characterizes change in complex systems (Marion, 1999). It derives from the collapse of built up tensions (Prigogine, 1997), sudden mergers (or divergences) of formerly separate CAS (Kauffman, 1993), or a cascade of changes through network connections (Bak, 1996). Creativity and learning occur when emergence forms a previously unknown solution to a problem or creates a new, unanticipated outcome (i.e., adaptive change).

CAS are unique and desirable in their ability to *adapt* rapidly and creatively to environmental changes. Complex systems enhance their capacity for adaptive response to environmental problems or internal demand by diversifying their behaviors or strategies (Holland, 1995; McKelvey, 2006). Diversification, from the perspective of complexity science, is defined as increasing internal complexity (number and level of interdependent relationships, diversity within CAS, number of CAS, and tension) to the point of, or exceeding, that of their competitors or their environment (i.e., "requisite variety," Ashby, 1960 or "requisite complexity," McKelvey and Boisot, 2003). Adaptive responses to environmental problems include counter-moves, altered or new strategies, learning and new knowledge, work-around changes, new allies, or new technologies. By increasing their complexity, CAS enhance their ability to process data (Lewin, 1992), solve problems (Levy, 1992), learn (Levy, 1992), and change creatively (Marion, 1999).

Certain conditions will affect the capacity of CAS to emerge and function effectively in social systems. Agents must, for example, be capable of interacting with each other and with the environment. Agents must be interdependently related, meaning that the productive well being of one agent or aggregate is dependent on the productive well being of others. Moreover, they must experience tension to elaborate.

This capacity to rapidly explore solutions can be illustrated with a problem solving scenario called annealing, which is found in the evolution and simulation complexity literature (Carley, 1997; Carley and Lee, 1998; Kauffman, 1993; Levy, 1992; Lewin, 1999). In this scenario, multiple agents struggle with localized effects created by a given environmental perturbations (or tension; this is called localized because an agent cannot usually perceive a problem as a whole nor do they typically have the capacity to deal with an environmental problem in its entirety). As these agents develop localized solutions, work-arounds, or related responses, they affect the behaviors of other interdependently related agents, who subsequently build on the original response to create higher-order responses. This process extends to broader network levels, to the fabric of interdependent agents, and to the CAS that defines the system or subsystem. In this process agents and CAS experiment, change, combine strategies, and find loopholes in other strategies – and, occasionally, unexpected solutions emerge that address the problem at some level.

Information flows in the annealing process are not necessarily efficient and agents are not necessarily good information processors. Nor does annealing imply that structural adaptations are embraced as official strategy by upper echelon administrators or that the process finds perfect solutions. The annealing process is imperfect and somewhat messy – as Carley (1997) puts it, "it may not be possible for

organizations of complex adaptive agents to locate the optimal form [but] they can improve their performance by altering their structure" (p. 25). The annealing process (and other processes described in the complexity literature; e.g., McKelvey, 2006; Prigogine, 1997)[1] does, however, find solutions that individuals, regardless of their authority or expertise, could not find alone. Levy (1992), for example, describes bottom-up simulations that out-performed humans at finding solutions to mazes. Marion (1999) argued that technological and scientific advances inevitably emerge from a movement involving numerous individuals rather than from the isolated minds of individuals.

In sum, CAS are unique and desirable in that their heterogeneous, interactive, and interdependent structures allow them to quickly explore and consolidate solutions to environmental pressures. They require new models of leadership because problem solving is performed by appropriately structured social networks rather than by groups coordinated by centralized authorities. As Mumford and Licuanan (2004) put it, effective leadership influence in conditions requiring creativity occurs through *indirect mechanisms* and through *interaction*.

Complexity is a science of mechanisms and interaction, and also is embedded in context. Mechanisms can be described as the dynamic behaviors that occur within a system, such as a complex adaptive system. As defined by Hernes (1998), mechanisms are "a set of interacting parts – an assembly of elements producing an effect not inherent in any of them" (p. 74). They are "not so much about "nuts and bolts" as about "cogs and wheels"... – the "wheelwork" or agency by which an effect is produced" (Hernes, 1998, p. 74). Contexts are structural, organizational, ideational, and behavioral features – the fabric of interactions among agents (people, ideas, etc.), hierarchical divisions, organizations, and environments – that help explain the nature of mechanisms. Examination of mechanisms and contexts in leadership would pry back the cover and help us to understand *how* and *under what conditions* certain outcomes occur.

To further explain this, we turn next to presentation of our framework for Complexity Leadership Theory. Complexity Leadership Theory is about setting up organizations to enable adaptive responses to challenges through network-based problem solving. It offers tools for knowledge producing organizations and subsystems dealing with rapidly changing, complex problems. It also is useful for systems dealing with less complex problems but for whom creativity is desired.

Complexity Leadership Theory

Complexity Leadership Theory is a framework for leadership that enables the learning, creative, and adaptive capacity of complex adaptive systems (CAS) within a context of knowledge producing organizations or organizational units. This framework seeks to foster CAS dynamics while at the same time enabling control structures appropriate for coordinating formal organizations and producing outcomes appropriate to the vision and mission of the system. It seeks to integrate bureaucracy and complexity dynamics, enabling and coordinating, exploration and exploitation, hierarchy and CAS, and top-down control and informal emergence.

Accomplishing this balance poses unique challenges for leadership, however: *How can organizations enable and coordinate informal emergence (where appropriate), and coordinate or structure systemic behavior, without suppressing its adaptive and creative capacity?*

As described above, complex adaptive systems are intensely adaptive and innovative (Cilliers, 1998; Marion, 1999). CAS obtain the flexibility to adapt that has been attributed to loose coupling (Weick, 1976) and the capacity to coordinate from a more interdependent structure that is best described as moderately coupled (Kauffman, 1993; Marion, 1999). That is, flexibility and what might be called, auto-coordination, derives from informal but interdependent structures and activities (auto-coordination emerges from the nature of system dynamics and is not imposed by authorities). Complexity theorists refer to informal interactive interdependency as bottom-up behavior, defined as behaviors and changes that emerge spontaneously from the dynamics of neural-like networks. However, the term bottom-up evokes images of hierarchy in organizational studies, so we will substitute the term *informal emergence* to describe these CAS dynamics in social systems.

Informal emergence and auto-coordination are seemingly incompatible with administrative coordination, but in reality it depends on the nature of the coordination. In complex adaptive systems, coordination comes from two sources: from constraints imposed by interdependent relationships themselves (auto-coordination) and from constraints imposed by actions *external* to the informal dynamic, including environmental restrictions (Kauffman, 1993; Marion, 1999) and administrative controls (McKelvey et al., 2003). *Internal* controls are imposed by a sense of common purpose that defines complex adaptive systems and from an inter-agent accountability that is inherent in interdependent systems (Marion and Uhl-Bien, 2001, 2003; Schneider and Somers, 2006). Osborn and Hunt (2007) evocatively describe such coordination elsewhere in this special issue in their discussion of the Highlander tribes of New Zealand. *External* constraints and demands are imposed by environmental exigencies and relationships; indeed the core of Stuart Kauffman's (1993) influential descriptions of complex activities in biological evolution involves the inter-influence of multiple interacting species.

In organizational systems, administrators in formal positions of authority likewise influence complex adaptive systems by imposing external coordinating constraints and demands Such constraints are valuable for (among other things) controlling costs, focusing efforts, allocating resources, and planning. However, authority imposed (top-down) coordination is not necessarily responsive to the potent dynamics of interdependent learning, creativity, and adaptability inherent in complex adaptive systems, and it tends to impose the understanding of a few on the "wisdom" of a neural network (Heckscher, 1994; McKelvey, 2006). That is, top-down control hampers the effective functioning of complex adaptive systems. This is particularly evident in systems with only top-down, hierarchical chains of authority, in systems with closely monitored, centralized goals, or in systems whose dominant ideology is authoritarian.

How, then, can organizations capitalize on the benefits of administrative coordination and of complex adaptive dynamics? Complexity Leadership Theory suggests

that the role of administrators is not necessarily to align worker preferences with centralized organizational goals. Rather, administrative leaders, particularly under conditions of knowledge production, should enable informal emergence.

A Framework for Complexity Leadership Theory

This leads us to our overarching framework for Complexity Leadership Theory. This framework envisions three leadership functions that we will refer to as adaptive, administrative, and enabling. *Adaptive leadership* refers to the actions and dynamics of interacting agents as they work together within a network of interactive, interdependent agents and CAS to resolve adaptive problems. Adaptive activity can occur in a boardroom or in workgroups of line workers; adaptive leadership is an informal dynamic that occurs among interactive agents and is not an act of authority. *Administrative leadership* refers to the actions of individuals who plan and coordinate organizational activities (see Yukl, 2005). Administrative leadership (among other things) structures tasks, engages in planning, builds vision, allocates resources to achieve goals, manages crises (Mumford et al., 2008) and conflicts, and manages organizational strategy. Administrative leadership is vested in formal authority roles within an organization. *Enabling leadership* works to create conditions in which adaptive leadership can thrive and enables the flow of adaptive knowledge from adaptive structures into administrative structures. Enabling leadership is most often vested in formal (often middle management) positions because of their access to resources and authority, but it may also be performed by informal agents as well.

In Complexity Leadership Theory, these three leadership functions are intertwined in a manner that we refer to as *entanglement* (Kontopoulos, 1993). Entanglement describes a dynamic relationship between the formal *top-down, administrative forces* and the informal, *complexly adaptive emergent forces* of social systems. In organizations, administrative and adaptive leadership interact, and may help or oppose one another. Administrative leadership can function in conjunction with adaptive leadership or can thwart it with overly authoritarian or bureaucratic control structures. Adaptive leadership can work to augment the strategic needs of administrative leadership, it can rebel against it, or it can act independently of administrative leadership. The enabling leadership function helps to ameliorate these problems; it serves primarily to enable effective adaptive leadership, but to accomplish this it must tailor the behaviors of administrative and adaptive leadership so that they function in tandem with one another.

One cannot disentangle hierarchy from CAS. Earlier we stated that CAS are the basic unit of analysis in a complex system. However, these CAS (or interactive systems cooperatively bonded by common focus) interact with formal substructures in a system. Further, there are times and conditions in which rationalized structure and coordination (hierarchy) need to be emphasized in subunits (e.g., when the environment is stable and the system seeks to enhance profits). At other times or conditions,

firm may prefer to emphasize complexity and CAS (e.g., when environments are volatile or the competition's flexibility is threatening).

A role of strategic leadership, then, is to manage the coordination rhythms, or oscillations, between relative importance of top-down, hierarchical dynamics and emergent complex adaptive systems (Thomas et al., 2005). Ultimately, neither can be separated from the other in knowledge producing organizations, for such firms must nurture both creativity and exploitation to be fit.

Based on this, we can summarize the main points (premises) we have developed thus far as follows:

Premise 1: Complexity Leadership Theory provides an overarching framework that describes administrative leadership, adaptive leadership and enabling leadership; it provides for entanglement among the three leadership roles and between CAS and hierarchy in an organizational system.

Premise 2: *Adaptive leadership* is a complex interactive dynamic that is the primary source by which adaptive outcomes are produced in a firm; *administrative leadership* is the function by which adaptive activities are organized and coordinated; *enabling leadership* serves to enable adaptive activities and to help adaptive outcomes move into the administrative realm. These roles are *entangled* across people and actions.

With this as the overarching framework, we now expand the elements introduced by Complexity Leadership Theory, beginning with adaptive leadership and then describing the enabling, and administrative roles. In this discussion we develop premises (conclusions derived from the literature from which further reasoning proceeds) and propositions (operationalizable conclusions that can be converted into one or more hypotheses) to guide future research in this area.

Adaptive Leadership

Adaptive leadership is a complex interactive dynamic that produces adaptive outcomes in a social system. It is a collaborative change movement that emerges nonlinearly from interactive exchanges, or, more specifically, from the "spaces between" agents (cf., Bradbury and Lichtenstein, 2000; Drath, 2001; Lichtenstein et al., 2006). That is, it originates in struggles among agents and groups over conflicting needs, ideas, or preferences; it results in, or contributes to, movements, alliances of people, ideas, or technologies, and cooperative efforts. Adaptive leadership is a dynamic rather than a person (although people are, importantly, involved); we label it leadership because it is *a*, and, arguably, *the,* proximal source of change in an organization.

Adaptive leadership emerges from asymmetrical interaction (the notion of complexity and asymmetry is developed by Cilliers, 1998). We propose two types of asymmetry: that related to authority and that related to preferences (which include

differences in knowledge, skills, beliefs, etc.). If an interaction is largely one-sided and authority-based, then the leadership event can be labeled as top-down. If authority asymmetry is less one-sided, then the leadership event is more likely based on interactive dynamics driven by differences in preferences.

Struggles over asymmetrical preference differences produce tension and adaptive change outcomes (thus the earlier statement that change emerges from the spaces between agents). Such tension-induced change takes the form of new knowledge and innovative ideas, learning, or adaptation; it is produced by the clash of existing but (seemingly) incompatible ideas, knowledge, and technologies. A familiar form of this change occurs when two individuals, who are debating conflicting perceptions of a given issue, suddenly, and perhaps simultaneously, generate a new understanding of that issue – this can be considered an "aha" moment. The "aha" is a nonlinear product of a combination of the original perceptions, of the discarding of untenable arguments and the fusion of what is tenable, or perhaps of the rejection of original ideas as untenable and the creation of a totally new idea. It represents a process of seeing beyond original assumptions to something not bounded by those assumptions. Moreover, it cannot be claimed by any one individual, but rather is a product of the interactions between individuals (i.e., it is produced in the "spaces between"; Bradbury and Lichtenstein, 2000).

> *Premise 3*: Adaptive leadership emerges from the interactions of individuals and CAS. It is induced by tension and interdependency.

This definition of adaptive leadership is, thus far, incomplete, for it doesn't address several crucial elements: (1) significance, (2) impact, and (3) network dynamics. *Significance* refers to the *potential* impact of adaptive outcomes on the fitness development of the system or on perceptions of knowledge that in turn influence fitness. The significance of an adaptive moment is related to the expertise of the agents who generate that moment (Mumford et al., 2002; Weisberg, 1999) and to their capacity for creative thinking (Mumford et al., 2003). Expertise and creativity are not necessarily co-resident in an adaptive event, of course. Quite obviously, creative individuals without training in physics are not going to advance that field, but neither are, one might argue, two physicists who are unable or unwilling to break out of their paradigmatic assumptions. Complex systems depend on the former (expertise) and stimulate the latter (creativity).

Impact refers to the degree to which other agents external to the generative set embrace and use a new idea. Impact can be independent of significance because impact is influenced by (among other things) the authority and reputation of the agents who generated the idea, the degree to which an idea captures the imagination or to which its implications are understood, or whether the idea can generate enough support to exert an impact (see Arthur, 1989) for discussion. Thus an insignificant idea can have considerable circulation.

What we speak of here, then, are adaptive dynamics that produce both significance and impact. In this case, adaptive leadership begins with a significant event and manifests as an outcome (Lichtenstein et al., 2006). It is not an act of an

individual, but rather a dynamic of interdependent agents and CAS. To manifest as an outcome (i.e., exert an impact), adaptive leadership must be embedded in an appropriately structured, neural-like network of agents and CAS.

Network dynamics refer to the context that enables adaptive leadership. In interactive and interdependent networks, adaptive ideas, whether small or large, interact in much the same way that *pairs* of agents interact, except that the conflictive dynamics of heterogeneous preferences are much more complex. In networks, there are complex patterns of conflicting constraints, direct and indirect feedback loops, accreting node[2] (ideas that are rapidly expanding in importance and which are accreting related ideas – this is emergence, as described earlier), and rapidly changing demands to which the system must adapt. The accreting node, or emergence, is the primary output of complex network dynamics. Networks are structured to permit information flows and interaction of ideas. Network dynamics include combination, divergence, and (as appropriate) the extinction of ideas; interdependent task conflicts; idea generation and accretion; adaptation to internal and external change and demand by adjusting their complexity; and CAS formation.

Premise 4: Adaptive leadership is characterized by impact and significance and couched within a dynamic network that enables its impact and significance.

Adaptive leadership, then, refers to interactions of individuals that produce emergent events and movements. It is a proximal source of change in an organization, and that change is the property of no particular individual. The key unit of analysis for adaptive leadership is the CAS, and the adaptive dynamic occurs in all hierarchical levels of an organization (Osborn and Hunt, 2007). The emergent outcomes of adaptive behaviors differs across hierarchical levels of course (Boal et al., 1992; Hunt and Ropo, 1995; Phillips and Hunt, 1992), as would their impact and significance. Broadly addressed, the adaptive outputs for the upper level of a hierarchy (what Jaques, 1989, called, the strategic level) relates largely to emergent planning, resource acquisition, and strategic relationships with the environment (for discussion, see Marion and Uhl-Bien, 2007; see also Child and McGrath, 2001, for a useful discussion of interdependency among organizations). Outputs for the middle hierarchical levels (middle management, or what Jaques, 1989, called, the organizational level) relates to enabling activities. That for the lower levels (Jaques' production level) relates to development of the core products of the organization; for knowledge producing organizations, this includes knowledge development, innovation, and adaptation.

The Adaptive Role

Complexity Leadership Theory proposes that individual agents within an adaptive dynamic appropriately act to support adaptive leadership; we label this the *adaptive role*. As described earlier, adaptive roles relate to tension, interaction, and

interdependency. We now discuss characteristics of effective adaptive behaviors of agents (defined here as individuals) in complex adaptive systems relative to these dynamics.

Agents in adaptive roles work to capitalize on tension mechanisms to produce effective adaptive outcomes. They recognize the creative value of tension and use it to foster productive discussions and interaction. They do not look to authority for answers, but rather commit to engaging in the process of adaptive problem solving. Adaptive agents recognize the difference between task (or ideational) conflict (which can produce creative outcomes; Jehn, 1997), and interpersonal conflict (which is disruptive to social dynamics) and they work to promote productive, task conflicts (Heifetz, 1994; Jehn, 1997; Lencioni, 2002). They contribute ideas and opinions, they play devil's advocate, and they address the "elephants on the table" that others try to ignore (Parks, 2005). They also recognize when a group is bogged down by consensus (Lencioni, 2002) that comes from lack of diversity, and expose the group to heterogeneous perspectives, bringing other people and ideas into the dynamic as necessary.

Individuals in the adaptive role engage in behaviors that enhance their interactive contributions. The creativity/leadership literature likewise supports the importance of interaction. West et al. (2003), for example, found a strong relationship between effective process leadership and the capacity to enable interaction. Agents in adaptive networks contribute to the flow of information by keeping themselves informed and knowledgeable on issues important to the firm and their field. They frame issues appropriate to the perspectives of the others with whom they are interacting and monitor the environment (e.g., political, economic, social, national, international, technological) to understand the nature of the forces that are influencing the dynamic.

Finally, individuals in adaptive roles recognize the importance of interdependency and they work to foster coordinated efforts when necessary. They refine or realign their information relative to the information of the other agents (Kauffman, 1993; Marion and Uhl-Bien, 2001) in ways that contribute to coevolution or co-elaborating of ideas and information such that new, sometimes surprising information can emerge (Kauffman, 1993).

> *Proposition 1*: Individuals promote adaptive dynamics by fostering interconnectivity of agents and ideas, by contributing to the interdependent coevolution of ideas, and by interacting effectively with tension mechanisms.

Enabling Leadership

Enabling leadership directly fosters and maneuvers conditions that enable adaptive leadership. Middle managers (Jaques, 1989) are often in a position to deal with enabling behaviors because of their access to resources and their direct involvement in the boundary conditions for the system's production level (Osborn and Hunt, 2007). However, enabling leadership can be found anywhere. Its role seemingly

overlaps, at times, that of administrative leadership in that it may be performed by agents acting in more managerial capacities. Moreover, a single agent or aggregate can perform either adaptive or enabling roles by merely changing hats as needed.

The roles of enabling leadership can be described as follows:

- Enabling leadership enables effective CAS dynamics by fostering *enabling conditions* in which adaptive leadership can emerge and respond to adaptive challenges.
- Enabling leadership helps engender relationships between administrative and adaptive leadership that protect the adaptive work (cf., Heifetz, 1994) of the organization, and helps disseminate innovative products of adaptive leadership upward and through the formal managerial system (i.e., the innovation-to-organization interface, Dougherty and Hardy, 1996).

Foster Enabling Conditions for Adaptive Leadership. The principal function of enabling leadership is to foster the conditions that promote effective CAS dynamics for adaptive leadership. As described earlier, complex networks conducive to adaptive leadership are (among other things) interactive, moderately interdependent, and infused with tension. Enabling leadership fosters complex networks by (1) fostering interaction, (2) fostering interdependency, and (3) enabling the conditions necessary to produce a fabric of *internal* tensions as well as injecting *external* tensions to help motivate and coordinate the interactive dynamic.

Effective network conditions are enabled first by *interaction.* Interaction produces the network of linkages across which information flows and connects. Enabling leaders cannot create the sophisticated dynamic linkages that characterize complex networks, nor can they accurately pre-calculate what constitutes the right amount of coupling. They can, however, create the general structure of complex networks and the conditions in which sophisticated networks can evolve. For example, interaction is enabled by such strategies as open architecture work places, self-selected work groups, electronic work groups (email, etc.), and by management-induced scheduling or rules structuring. Moreover, the interactive imperative is not bounded to the immediate work group, but extends to interactions with other groups and with the environment. Interaction with other groups fosters cross-group initiatives, possible aggregation of different ideas into larger ideas, a degree of coordination across efforts, and the importation of information that may inform the target work group.

Further, enabling leadership helps foster interactions with environmental dynamics. This serves at least two purposes: it enables importation of fresh information into the creative enterprise (Boisot, 1998), and it broadens the organization's capacity to adapt to environmental changes and conditions beyond the adaptive capacity of strategic leadership acting alone. Marion and Uhl-Bien (2007) propose that organizational adaptability should even be a significant element of strategic planning because of its capability to adapt quickly and competently to environmental changes; a particularly potent example is evident in the adaptive strategies of terrorist networks (see Marion and Uhl-Bien, 2003).

Proposition 2: Enabling leaders manipulate the interactive conditions from which complex adaptive dynamics and their adaptive outcomes can emerge (e.g., by fostering interconnectivity and creating linkages among agents and ideas).

Interaction alone is insufficient for complex functioning; the agents in a system must also be *interdependent*. While interaction permits the movement and dynamic interplay of information, interdependency creates pressure to act on information. Interdependency's potency derives from naturally occurring networks of conflicting constraints. As described above, conflicting constraints manifest when the well-being of one agent is inversely dependent on the well-being of another, or when the information broadcasted by one agent is incompatible with that broadcasted by another agent. Such constraints pressure agents to adjust their actions and to elaborate their information.

There are a number of ways to manage conditions that enable interdependency mechanisms. One useful tool for promoting interdependency is to allow measured autonomy for informal behavior (see also Shalley and Gilson, 2004). Autonomy permits conflicting constraints to emerge and enables agents to work through those constraints without interference from formal authorities. Nordstrom illustrates this approach in a statement in their employee handbook:

> We also encourage you to present your own ideas. Your buyers have a great deal of autonomy, and are encouraged to seek out and promote new fashion directions at all times. . . and we encourage you to share your concerns, suggestions and ideas. (Pfeffer, 2005, p. 99)

A major function of leaders has historically been to solve problems, to intervene when dilemmas arise or when individuals differ on task-related activities. Such action, however, can stifle interdependency and limit adaptive mechanisms. Complexity Leadership Theory proposes circumspection by administrative leaders in such matters, to resist the temptation to create an atmosphere in which workers bring their work problems to management (see Alvesson and Sveningsson, 2003).

Enabling leaders can foster interdependency with rules – not limiting bureaucratic rules but rules or conditions that apply pressure to coordinate (McKelvey et al., 2003). Microsoft's™ strategy for developing software, for example, is built on interactive work groups and rule-enabled interdependencies (Cusumano, 2001). Programmers operate independently and in small groups, but are periodically required to run their code against the code of other programmers. If there are problems, the team must repair the incompatibility before moving on. Microsoft calls this "sync and stabilize." The process imposes interdependency that can create cascading changes and elaboration in Microsoft's software. Microsoft gains the benefit of flexibility, adaptability, speed, and innovation while maintaining coordinated action.

Proposition 3: Enabling leaders manipulate conditions, such as rules and autonomy, which foster emergence of interdependent mechanisms and their adaptive outcomes.

Finally, since tension creates an imperative to act and to elaborate strategy, information, and adaptability, enabling leadership also works to foster *tension*. *Internal* tension can be enhanced by heterogeneity, a stimulus of interdependency and conflicting constraints. Heterogeneity refers to differences among agents in such things as skills, preferences, and outlooks (McKelvey, 2006; Schilling and Steensma, 2001). When couched within a context of interdependency, heterogeneity pressures agents to adapt to their differences. Enabling leadership promotes heterogeneity by (among other things) building an atmosphere in which such diversity is respected, with considered hiring practices, and by structuring work groups to enable interaction of diverse ideas. It also fosters internal tension by enabling an atmosphere that tolerates dissent and divergent perspectives on problems, one in which personnel are charged with resolving their differences and finding solutions to their problems (cf., Heifetz and Laurie, 2001). Enabling leaders create conditions that foster interactive problem solving rather than individual decisiveness.

Enabling leaders not only foster internal tension, they judiciously inject tension as well – tension that derives externally in that it is not a natural function of informal dynamics. They inject tension with managerial pressures or challenges, by distributing resources in a manner that supports creative movements, creating demands for results. Enabling leaders can impose tension by dropping "seeds of emergence" (Marion and Uhl-Bien, 2001; McKelvey et al., 1999), or perturbations that have the potential of fostering learning and creativity. They include ideas, information, judiciously placed resources, new people, and the capacity to access unspecified resources (i.e., gateways that permit exploration; access to the internet is an obvious example). Seeds are intended to stimulate the networked system, and their impact may be unpredictable.

> *Proposition 4*: Enabling leaders manipulate the conditions under which adaptive tension mechanisms and their adaptive outcomes can emerge (e.g., by promoting heterogeneous interactions, encouraging agents to solve their own problems, injecting tension, or "dropping seeds of emergence").

Enabling leadership can be enacted by agents in formal organizational roles; such agents are effective in part because they have access to resources and authority needed to accomplish certain enabling dynamics. Enabling leadership can also emerge from within the adaptive function, however. Schreiber (2006), in a study of complexity leadership and risk factors, identified several interesting enabling dynamics in work groups (measurements from these observations were used in a follow-up multi-agent based simulation). Certain agents, for example, tended to induce interactions and establish interdependencies. Others were boundary spanners, or "agent[s] who most likely connect. . . to otherwise disjoint groups" (p. 136). Some agents were "likely to have the most interactions and to learn more knowledge" (p. 136). There were also agents "who can most quickly communicate to the organization at large" (p. 136). Lastly, some agents were "most likely to communicate new knowledge" (p. 136). Such agent-roles represent nodes in a neural network

of agents (see e.g., Carley and Ren, 2001) and serve to enable (and operationalize) interaction, interdependency, and learning within CAS.

Promoting Coordination between Adaptive and Administrative Structures. A second function of the enabling leadership role is to promote coordination of CAS dynamics and formal administrative systems and structures. This involves using authority (if applicable), access to resources, and influence to keep the formal and informal organizational systems working in tandem rather than counter to one another (Dougherty, 1996). Howell and Boies (2004) refer to this as championing. They argue, describing creative ideas, that:

> To overcome the social and political pressures imposed by an organization and convert them to its advantage, champions demonstrate personal commitment to the idea, promote the idea... through informal networks, and willingly risk their position and reputation to ensure its success... [They] establish... and maintain... contact with top management, to keep them informed and enthusiastic about the project.... [A] new venture idea require[s] a champion to exert social and political effort to galvanize support for the concept. (p. 124)

Specifically, enabling leadership (1) works to prevent administrative leaders from stifling or suppressing beneficial interactive dynamics; (2) fosters adaptive behaviors that are consistent with the strategy and mission of the organization; and (3) facilitates the integration of creative outcomes into the formal system. Regarding the first of these roles, enabling leaders help protect the CAS from external politics and top-down preferences. They serve to influence the policies and decisions of administrative leadership to accommodate the needs of adaptive structures (Dougherty and Hardy, 1996). They also help align organizational strategy to the needs of CAS dynamics and convince administrative leadership when CAS dynamics are important for organizational strategy (Marion and Uhl-Bien, 2007). Finally, they work to align adaptive structures themselves with the strategic focus of the organization (Mumford et al., 2008).

Second, enabling leaders help in the innovation-to-organization interface. As noted by Dougherty and Hardy (1996), formal organizational systems are often not structured to foster internal dissemination of innovation – rather, they tend to inhibit it. Because formal structures present obstacles for innovation-to-organization transference, power is needed to facilitate, orchestrate, and share innovative ideas and outcomes throughout the organization. "Unless product innovation has an explicit, organization-wide power basis, there is no generative force, no energy, for developing new products continuously and weaving them into ongoing functioning" (Dougherty and Hardy, 1996, p. 1146). They suggest that organizations adopt a "pro-innovation" approach by moving beyond reliance on networks of personal power (a focus on individuals) and toward an organization-system base of power. Such a system would foster processes that "link the right people" and "emphasize the right criteria," as well as "allow resources to begin to flow to the right places" (Dougherty and Hardy, 1996, p. 1149). Enabling leaders can play an integral role in helping design and protect such a "pro-innovation" organizational system.

Enabling leadership also works with adaptive and administrative leadership to decide which creative outputs of the adaptive subsystem are the most appropriate to move forward into the broader bureaucratic structure. In conducting this function,

Mumford et al. (2008) caution administrators to avoid assessing the creative output itself and to instead focus on assessing the degree to which activities are accomplishing the functions of the given stage of development. "Evaluation," they argue, "should be viewed as a developmental exercise with multiple cycles of evaluation and revision occurring in any stage before planning progresses to the next stage" (in press).

> *Proposition 5*: Enabling leaders help coordinate the interface between adaptive and administrative leadership by working for policies and strategies that enable complex dynamics and by adopting a "pro-innovation" environment that facilitates innovation-to-organization transference.

Administrative Leadership

As defined earlier, administrative leadership refers to the actions of individuals who plan and coordinate organizational activities. Administrative leaders (among other things) structure tasks, engage in planning, build vision, allocate resources to achieve goals (Dougherty and Hardy, 1996; Shalley and Gilson, 2004), manage crises (Mumford and Licuanan, 2004) and conflicts, and manage organizational strategy. Importantly, they act to structure creativity, adaptability, and initiative throughout the organization and within specific sub-functions whose creativity is crucial to the firm (see Marion and Uhl-Bien, 2007).

Administrative leadership is vested in formal authority roles within an organization. The challenge posed earlier for administrative leadership is: How does administrative leadership administer and coordinate informal emergence and structure the firm's systemic flows without suppressing its adaptive and innovative capacity? We take up this challenge in this section by discussing planning, managing resources, coordination, and structuring conditions.

The nature of this challenge will vary within the hierarchical level of the system. Administrators at Jaques' (1989) strategic level engage in planning, coordination, resource acquisition (Osborn and Hunt, 2007), and structuring conditions to the extent that they relate to strategy (Marion and Uhl-Bien, 2007). At Jaques' organizational level, administrators implement more focused planning and coordination of creative operations, manage resource allocation, and structure conditions within which adaptive leadership occurs. We discuss both of these levels below.

Planning. Mumford et al. (2008) have argued that R&D programs must be understood in the long term and that leaders of R&D are managers of systemic dynamics. Jaques (1989) states that higher levels of a hierarchy deal with increased cognitive loads, which include planning for long time frames. Similarly, Complexity Leadership Theory proposes that strategic level administrators (among other things) plan a trajectory for the R&D process and have a long-term outlook (Marion and Uhl-Bien, 2007). Administrators at the organizational level plan the context surrounding work (see Mumford and Licuanan, 2004) and articulate a creativity mission (Jaussi and Dionne, 2003). Administrative leadership, in general, assumes

a time-dependent, systemic relationship with complex dynamics, one in which the responsibility is to provide the framework and conditions within which adaptive leadership functions.

Planning is a common strategy used by administrators at both Jaques' strategic and organizational levels to coordinate organizational behavior. Mumford et al. (2008) note a lack of consensus in the leadership literature about whether creativity is enabled or hampered by administrative planning (Bluedorn et al., 1994; Finkelstein and Hambrick, 1996). Some researchers argue that planning provides the resources and structure that creative initiatives require while others argue that administrators cannot anticipate and plan the directions in which creative dynamics will flow (Mumford et al., 2008). Framing the question for Complexity Leadership Theory, we ask: Does planning enable or inhibit nonlinear emergence? Our short answer is: It depends on the nature of the plan.

Planning for creativity must deal with significant uncertainties, including the fact that creativity by definition involves development of ideas that are currently unknowable (Popper, 1986), changing future environmental uncertainties, and uncertainty about whether creative ideas will become viable market solutions. Mumford and colleagues (Mumford et al., 2008; Mumford et al., 2002) propose evolving and flexible plans to deal with such uncertainties. They divide their planning model into five stages: (1) scanning, (2) template planning, (3) plan development, (4) forecasting, and (5) plan execution. These stages can be summarized as idea identification (scanning and template planning), plan development (including forecasting), and plan execution. Mumford et al. (2000a) argue that plans should be adapted to the needs of each stage and that planning within these stages should be a continuous process in order to adjust for changes and unknowns that are certain to arise.

Complexity Leadership Theory (CLT) has similar concerns about planning. On the one hand, emergence is the product of informal adaptive behavior that would be hampered by top-down restrictions (Krause, 2004). On the other hand, the need to focus creative behaviors is legitimate; indeed unrestrained adaptive behavior would be expensive to support. Mumford et al. (2008) propose that organizational plans should impose limits that assure creative emergence is consistent with the core competencies (or theme) of the system. This focuses creativity around practical constraints without unduly dampening the creative spirit. We further propose that planners separate the creative process from the structure in which it occurs: The creative process itself (e.g., adaptive behaviors) should not be unduly managed or constrained by administrative planning and coordination; however that process should be couched within a larger planning structure similar to that proposed (above) by Mumford and his colleagues.

> *Proposition 6*: Administrative leadership creates the superstructure within which creative, learning, and adaptive dynamics occur without imposing on the processes by which they occur (e.g., administrative leadership coordinates creative activities around organizational themes, creates support structures, and structures temporal flows from idea conception to implementation).

Managing Resources. Administrative leadership manages the resources required by adaptive structures: At the strategic level, administrative leadership engages primarily in resource acquisition and at the organizational level, administrative leadership primarily addresses resource allocation. The literature on creativity has noted the importance of administrative behaviors that increase the availability of information (Reiter-Palmon and Illies, 2004). Similarly, complex adaptive systems depend on flows of information resources, and when such flows are hindered, they do not operate effectively. In Complexity Leadership Theory, administrative leadership provides resources that enhance access to information (e.g., access to electronic databases).

Personnel are resources, and diversity of personnel skills and preferences is important to the adaptive leadership function. Administrative leaders, then, promote diversity in hiring practices and policy actions. Bonabeau and Meyer (2001) argue that leaders can enhance the adaptive process by allowing resources (e.g., money, supplies, etc.) to follow emergent ideas (see also Dougherty and Hardy, 1996). This fosters motivation and creates tension related to scarce resources.

> *Proposition 7*: Administrative leadership coordinates acquisition and allocation of resources (money, supplies, information, personnel, etc.) that support creative, learning, and adaptive behaviors of CAS.

Structuring Contexts. Finally, administrative leaders structure the context (defined earlier as the fabric of interactions among agents – people, ideas, etc. – hierarchical divisions, organizations, and environments) within which adaptive leadership can thrive. A number of researchers have examined the conditions in which creativity occurs. Jaussi and Dionne (2003), for example, suggest that leaders structure creative efforts by providing mission statements (e.g., Kennedy's mission to put Americans on the moon by 1970). Complexity Leadership Theory adds (as does Mumford et al., 2008) that such missions should not be so specific that they restrict the creative process, and that they should be sufficiently flexible to change with changing conditions. Administrative leaders deal with crises that threaten to derail adaptive functions (Mumford et al., 2008) and they protect the creative process from forces (e.g., boards or directors, other administrators, environmental pressures) that would limit the capacity of the organization or its subsystems to engage in creativity, learning, and adaptation.

> *Proposition 8*: Administrative leadership structures conditions such as missions, physical conditions, crises, conflicts, and external threats in ways that support creative adaptive behaviors.

In sum, Complexity Leadership Theory is a framework for studying emergent leadership dynamics in the context of bureaucratic superstructures. Three roles were described in this article (adaptive, enabling, and administrative), and these roles differ according to where they occur in the larger organizational hierarchy. As described in the orienting assumptions outlined earlier in this article, the basic unit

of analysis of CLT is complex adaptive systems (or CAS). Complexity Leadership Theory proposes that CAS exist throughout the organization and are entangled with the bureaucratic functions such that they cannot be separated. CLT proposes that CAS, when functioning appropriately, provide an adaptive capability for the organization, and that bureaucracy provides an orienting and coordinating structure. A key role of strategic-level leadership (Jaques, 1989) is to effectively manage the rhythmic emphases of these two functions (Thomas et al., 2005) in a manner that enhances the overall flexibility and effectiveness of the organization (Marion and Uhl-Bien, 2007). By focusing on emergent leadership dynamics, CLT implies that *leadership* only exists in, and is a function of, interaction. Despite this, there are roles for individual *leaders* in interacting with this dynamic.

Conclusion

As described by Rost (1991), leadership study has been bogged down in the periphery and content of leadership, and what is needed is "a new understanding of what leadership is, in a postindustrial school of leadership" (Rost, 1991, p. 181). In the present article we attempt to move toward such an understanding by developing a model of leadership based in complexity science. Complexity science is a modern "normal" science, the assumptions of which fit the dynamics of social, managerial, and organizational behavior in high velocity, knowledge-type environments (Henrickson and McKelvey, 2002). Complexity science allows us to develop leadership perspectives that extend beyond bureaucratic assumptions to add a view of leadership as *a complex interactive dynamic through which adaptive outcomes emerge*. This new perspective, which we label Complexity Leadership Theory, recognizes that leadership is too complex to be described as only the act of an individual or individuals; rather, it is a complex interplay of many interacting forces.

Complexity Leadership Theory focuses primarily on the complex interactive dynamics of CAS and also addresses how individuals interact with this dynamic to influence adaptive outcomes. CAS are the minimum units of analysis in Complexity Leadership Theory, thus they are the principle object of theory, propositions, and research. CAS are comprised of agents, however, and their roles in the CAS dynamic is important. Further, individuals (particularly those in positions of authority) can influence the CAS function and are likewise of interest in Complexity Leadership Theory.

Research on CAS in Complexity Leadership Theory should examine the dynamic (i.e., changing, interactive, temporal), informal interactive patterns that exist in and among organizational systems. This generates interesting questions for leadership research. For example, what patterns of behavior (what Allen, 2001, calls, structural attractors) do organizational CAS gravitate to and are there "patterns to those patterns" across systems? What is the specific generative nature of asymmetry and how does it function within a network dynamic? What enabling functions emerge from a complex network dynamic (such as those found by Schreiber, 2006)? What psycho-social dynamic occurs in the "spaces between agents" emergent dynamic?

What are the mechanisms by which a social system moves from one stable pattern to another? What contexts are conducive to given patterns of interaction and how do enabling and administrative leaders help foster those contexts?

A complexity leadership approach adds to leadership research a consideration of the *mechanisms* and *contexts* by which change occurs and systems elaborate rather than a predominant focus on *variables*. To understand mechanisms requires methodology that is capable of analyzing the interactions of multiple agents over a period of time. Developing an understanding of the mechanisms that underlie Complexity Leadership Theory and the conditions in which such mechanisms will emerge is critical as we move our theorizing forward into embedded context approaches in leadership (Osborn et al., 2002). There can be any number of mechanisms underlying the Complexity Leadership Theory function. In this article we focus on interaction, interdependency and tension (Kauffman, 1993; Marion and Uhl-Bien, 2001; McKelvey, 2006). However, there can also be a number of "sub-mechanisms," such as interaction among heterogeneous agents, fitness searches (Kauffman, 1993), annealing, requisite variety, information flows, and nonlinear emergence.

Research regarding complexity dynamics needs to capture the nature of mechanisms, which are nonlinearly changeable, unpredictable in the long term (and sometimes in the short-term), temporally based, and interactively and causally complex. We suggest two methodological strategies for doing this. First, qualitative procedures allow temporal evaluations and have been used in complexity studies (Bradbury and Lichtenstein, 2000). Second, various computer modeling procedures have been utilized for complexity research, the most common being agent based modeling (Carley and Svoboda, 1996) and system dynamic modeling (Sterman, 1994).

In agent based modeling, individual, computerized agents are programmed to interact according to certain defined rules of sociological and organizational engagement (Carley and Svoboda, 1996). In systems dynamics, agent or variable interaction is based on equations that define relationships. In either case, a common approach is to measure certain characteristics of a social group (e.g., organizational work groups) and to use those data as initial conditions in a simulation. This obviates the need to make detailed, onsite observations across time and permits the researcher to experiment with "what-if" scenarios (e.g., what if hierarchical centralization is increased).

In sum, in this article we develop and outline key elements of Complexity Leadership Theory. We argue that while the knowledge era calls for a new leadership paradigm, much of leadership theory still promotes an approach aimed at incentivizing workers to follow vision-led, top-down control by CEOs (Bennis, 1996; Zaccaro and Klimoski, 2001). Though this approach fits recent trends toward performance management and accountability, it can stifle a firm's innovation and fitness (Marion and Uhl-Bien, 2001; Schneider and Somers, 2006). We propose that Complexity Leadership Theory offers a new way of perceiving leadership – a theoretical framework for approaching the study of leadership that moves beyond the managerial logics of the Industrial Age to meet the new leadership requirements of the Knowledge Era.

Notes

1. There are other problem-solving approaches in the literature. Complex systems can, e.g., respond with phase transitions to new states that is caused by a build-up of tension (McKelvey, 2006; Prigogine, 1997). All problem-solving strategies, however, are, in some fashion, driven by tension.
2. The notion of accreting nodes is derived from related work in fractal geometry (see e.g., Mandelbrot, 1983).

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