Complexity Theory as a Leadership Framework

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Educational leadership is beginning to make use of new scientific ideas to help frame and explain the intricate nature of its enterprise. Old ideas about leadership that evolved during the industrial era are giving way to new ideas born in the information age. Managers have changed into team members, piece workers have become knowledge workers, and bosses have become leaders. Old linear ways of thinking and representing change need to complete their transformation into complexity theories of change. As Michael Fullan (1994) points out, "educators must see themselves and be seen as experts in the dynamics of change" (p. 4).

Complexity theory develops the technical language and metaphors needed to construct a wholistic picture that experts can use to understand and articulate those dynamics. For example, the idea of a boundary has been used in traditional leadership studies to point out a role for leaders in scanning the external environment. Those external circumstances are often pictured as offering threats and opportunities for the organization. In complexity theory, the technical language is extended to "boundary conditions," and takes on subtle new variations of meaning that apply to both external and internal factors.

First, boundaries do not only separate an organization from its environment. They define the internal and external interchanges between the system, its subsystems and their respective environments, which can include other internal parts of the organization as well as the outside. Boundary conditions are defined not only by a line that separates things, but also by a leader's conception of the system's elements in a representation of the whole or any of its parts. Whole system pictures thus have boundaries at both inside and outside limits just like subsystem pictures do. The new understanding through the technical language of complexity theory underscores that all pictures are incomplete, partial understandings, even when we think that "all "of the important components are taken into account. In fact, to some extent the limit of our knowledge, as represented in our articulated understandings and pictures, is what creates the boundaries!

Second, the boundary has more functions than in the traditional version as the place to look for threat or opportunity from outside the organization. Complexity theory teaches us that there are self-imposed limits and mutual or reciprocal relationships which also create boundaries and structural conditions. The interchanges at boundaries are not monothematic across the entire set of interchange points; and in addition, there may be many simultaneous exchanges occurring. In systems dynamics modeling, boundary conditions are treated quantitatively as variables.

As the example of boundary illustrates, complexity theory offers traditional leadership frameworks an expansion and addition of subtleties to some traditional concepts. Another addition offered by complexity theory is the creation of a completely new, quantitative interpretation and integration of traditional ideas with new explanations. An example of the new integration is the concept of structural behavior.

A traditional approach in organizational behavior (OB) might look at work flow, team structure, communication patterns, proximity of resources, and so forth, and design interventions by moving those structures and patterns into new arrangements. The

choices of which new arrangements to use in traditional OB is guided by experience and taste or perhaps by independent theories of maximizing or minimizing benefits and costs among the variable sets that traditionally are thought to work together. Maxims gained through experience suggest the OB values. "People in teams have higher communication needs." "Proximity of resources reduces distribution costs." However, it is now known that in complex systems, unintended consequences of decisions can swamp an effort. Complexity is nearly impossible to predict and control, even in the short term, without a more rigorous approach to modeling than is possible through lists of maxims.

The systems dynamics modeling approach unifies the values of the ranges of traditional maxims into variables in a model simulator that offers wide experimental exploration of options. Instead of maxims, the new leadership framework creates quantifiable models of the maxims, which turns them into functional submodels with well-determined behavior. Lest one worry that we are headed toward simple determinism, it is important to note that we aren't. Due to the structural behavior of nonlinear dynamical systems, simply behaving subcomponents can lead to all kinds of complexity through essentially three forms of temporal organization: fixed points, periodic, and chaotic behavior. Thus, from simple but richly embedded parts complexity emerges—like an oak tree from an acorn.

Other leadership concepts are also introduced or updated by complexity theory. Networks of relationships are exploited for their structural dynamical implications. Archetypal patterns of structural behavior are used to create recognizable leadership options and leverage points. Initial conditions and attractors offer leaders concrete objects for reflecting on the historical and contemporary sources of influence in their systems. Because of these new possibilities, leadership has new territory to explore.

1) How can the systems dynamics modeling strategy be used practically in leadership and policy studies, research and daily practice, and

2) What are the implications of the complexity theory knowledge based on the design of leadership training and support systems?

Systems Dynamics Modeling as a Leadership Strategy

One of the great benefits of the invention of language was the beginning of an accumulation of cultural knowledge that could be transmitted from generation to generation. With written language, in addition to passing along genes and oral stories for improved adaptability to environments, a sustained cultural evolutionary process could begin. Organizations today continue in this tradition by transmitting their cultures and practices through symbols, organizational structure, human relationships, and technologies used by the organization in its primary activity.

All of the transmitting mechanisms reflect the mental models of the individuals in the collective and historical organization, with the most influential individuals usually having the highest degree of self-reflection and power of expression. Systems dynamics modeling with STELLA adds a new planning technology and set of symbols that can further democratize the leadership process by involving many people in the building of workable systems models. The process of model creation can be used to deepen a

leadership team's understanding of the structure and behavior of some aspect of the organization because the symbols and planning processes needed for successful modeling impose a new discipline on the leadership team. The symbols require clear thinking because they must have unambiguous roles and requirements specified before the simulations will run. The planning processes force the team to complete one phase before another dependent phase will work, and the entire process results in a stable picture that documents the group's knowledge and assumptions up through that point in time. By stability, it is meant that a new observer can pick up the documentation of the model and will be able to reliably reconstruct and interpret the group's knowledge and assumptions that are implicitly embodied in the model.

The notion of a new organizational language leads to one of several implications of using the systems dynamics modeling strategy as a research tool. As a focus of leadership team-based action research, the systems dynamics orientation builds mental models that have explicit indicators identified for every element in the model. This facilitates measurement, monitoring and accountability. In addition, independent of the issue of measurement, the modeling process stimulates strategic and tactical thinking by making it easy to have a dialogue between strategic options and the behavior of the model.

A second research possibility is in post hoc data analysis and theory building. All forms of data are potentially useful to systems modeling, but especially relevant are data collected with a reliable time parameter as a secondary field to the primary variables in the observation. The reason for this is that systemic changes of all kinds must take place in time and the traces or evidence of those changes are critical to our understanding the dynamics of the system.

A third type of research use of systems dynamics modeling is hypothesis testing. Where the action research approach mentioned earlier builds a theory or hypothesis through a leadership team's shared knowledge and experience, and the post hoc analysis focuses on existing data, the third type of use emphasizes what can happen with a pre-existing theory or hypothesis. The systems dynamics modeling approach can begin with prior research including the theories and hypotheses of that work. The modeling process attempts to interpret the structural implications of the research and then applies the data from the original research in a new way, as the values of critical variables driving the behavior of the model exemplifying the theory.

A fourth research use of systems dynamics modeling is as a bridge between qualitative and quantitative methods. Modeling can begin with either method and of necessity, it will build a combined picture. The graphical interface of STELLA is a qualitative description of the elements and relationships in a system. If no quantitative data are available, and no reasonable basis for estimating values of quantitative variables exists, that qualitative picture can still be a useful adjunct to a research process. But if variables can be quantified, then the equations and displays of a completed model will automatically include the qualitative picture, bridging the two descriptions. In fact, both the equations and displays are actually created by the qualitative symbols through additional background specification of the quantitative parameters of each element and relationship. In this sense the method can be qualitatively driven toward a quantitative result.

A final use of systems dynamics modeling brings the discussion out of research and into teaching or staff development. Here, the focus shifts to leadership training. Systems dynamics modeling in a core instructional program for leaders has both content and problem solving opportunities. A successful model used as an assessment opportunity is a test of one's ability to synthesize using the knowledge and processes one possesses. So as an instructional outcome, building a model opens many opportunities for acquiring and using new knowledge of content and processes. Due to the features already discussed, the task of building a model also builds deep understanding and forces one to be clear about one's ideas.

Developing Leadership Skills with Complexity Theory

In order for leaders to use the theory in their daily practice, three essential requirements must be met. Leaders need the conceptual tools, the vocabulary of the new domain, and ample practice in using the concepts and vocabulary to solve leadership problems. With these in hand, leaders can develop over time the ability to reflect on the archetypal patterns of structural behavior as exhibited in practical situations. Helpful to the growth process, an additional requirement is a familiarity with the rich interdisciplinary literature on complexity for example, in social systems, biodiversity, ecological systems, evolutionary sciences, intelligence, and the dynamics of complex systems.

Finally, the study of systems dynamics and leadership is just beginning. As a generative and evolutionary theory, complexity theory acknowledges the essentially creative role played by structural dynamics. And it metaphorically extends that capability to any part, any individual, of sufficient complexity. Distributed and constructivist leadership models will find a helpful and robust framework partner. Individual leaders will find in complexity theory a subject of surprising simplicity that is subtly capable of endless variation and depth as they pursue ever greater powers of understanding and representing their own understandings of complex systems in order to design organizational systems and take action.

REFERENCES:

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