THE LEADE COMPL

Today's complex world requires leaders to embrace complexity theory

by Everard van Kemenade

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JUST THE FACTS

A quick, informal search of the QP archives shows you that systems and complexity are written about frequently as they relate to quality management. And while quality professionals often use "systems" and "complexity" interchangeably, there are key differences between systems theory and complexity theory.

The author distinguishes between the two theories and focuses on the consequences of complexity theory for leadership—specifically how the uncertainty and complexity of today's world require emergent 21st century leadership.

Searching the QP digital archives at qualityprogress.com for the term "systems" brings back more than 3,000 results. The word "systems" is used in many different ways. The April 2020 issue, for example, mentions "systems perspective,"[1] "open systems"[2] and "system leaders."[3] Searching for the term "complex" returns more than 1,000 results (such as the article, "The Hidden Hospital").[4]

Of course, this search engine is not meant for scientific research, and many of the results will not be exactly what you are looking for. You can conclude, however, that "systems" and "complexity" are popular in the writings about quality management.

Quality professionals use the terms "systems" and "complexity" easily and often interchangeably. However, there are crucial differences between systems theory and complexity theory. This article aims to clarify the similarities and differences between the two theories. This is important because the uncertain and complex times we are in—especially due to COVID-19—require new, emergent 21st century leadership.

History

There is a debate about who first developed systems theory, but most scientists recognize Ludwig Von Bertalanffy as its godfather.[5, 6] Although this is not a contest about who was first, Von Bertalanffy promoted general systems theory back in 1950. The theory emphasized holism over reductionism and organism over mechanism. Van Bertalanffy distinguished between open and closed systems, defining a system as a set of elements standing in interrelation among themselves and with the environment. A central phenomenon in his thinking is the concept of feedback.

Another important systems thinker is Kenneth E. Boulding, who may have been the first person to stress the importance of systems in management science.[7] He created a classification of systems in nine categories—frameworks, clockworks, thermostat, cell, plant, animal, human, social organizations and transcendental systems. Systems thinking focuses on each of the constituent parts of a system and how they interrelate—for example, by assessing the number of components and interactions.

Early systems thinkers ultimately aimed to improve their ability to predict and control the system in question. Systems thinking is centered around having a goal. By using a goal, the ideal end state is defined and the process is all about how to close the gap between the current state and the end state.

Systems have become a crucial part of quality management. In a systems way of thinking, you need a quality management system (QMS) to achieve quality products and services. Systems such as the Malcolm Baldrige National Quality Award support the quality improvement process.

Systems theory often is seen as the foundation of complexity theory. Systems theory discussed topics such as complexity and self-organization long before complexity theory was born. Systems thinking is a way of knowing the complexity and trying to simplify it. In systems theory, complexity is the point at which elements within a system find balance, and the internal and external are aligned to the best interest of the whole. So, you could say that complexity theory originated from systems theory and shares a common vocabulary with it, such as complexity, emergence and properties.

A further development with systems theory is system dynamics. System dynamics was created during the mid-1950s by Jay Wright Forrester of the Massachusetts Institute of Technology. His most famous book was *Industrial Dynamics*.[8] Systems dynamics deals with the simulation of (dynamic) interactions between objects. W. Ross Ashby popularized cybernetics and further developed systems theory, especially fundamental ideas such as the principle of self-organization.[9, 10] Peter M. Senge also is considered to be a representative of systems dynamics.[11]

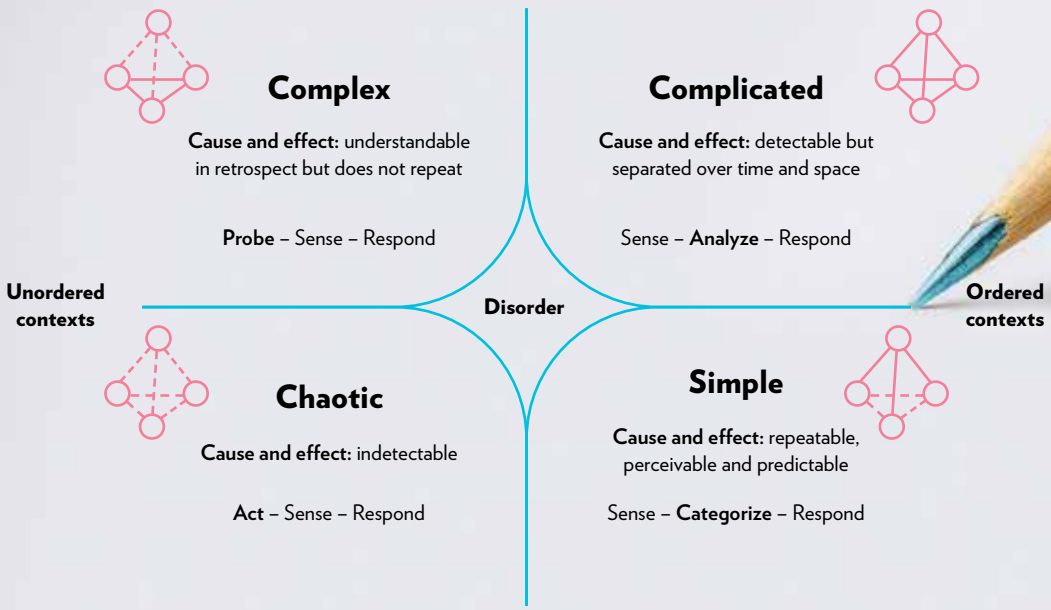
Intermediary conclusion

Systems thinking made an enormous contribution to the understanding of organizations. Complexity theory evolved from systems theory, supported by other disciplines. Systems thinking and complexity theory attempt to make the leadership and management of actionable problems work efficiently to the best target state possible. They consider systems to be open and changing.

Because they use the same language and concepts, people often say that complexity theory is a stage of

FIGURE 1

Cynefin model



Source: David J. Snowden and Mary E. Boone, "A Leader's Framework for Decision Making," *Harvard Business Review*, November 2007, https://tinyurl.com/hbr-leaders-framework.

optimization in systems thinking. Pearl Zhu, for example, mentions complexity theory to be "old wine in a new bottle."[12] Robert Louis Flood considers complexity theory to be another strand in systems thinking.[13]

This article, however, states that chaos theory leads the thinking about complexity in a new direction. What is distinctive in complexity theory compared to systems theory is the clear identification of predictability's limits.[14] Complexity theory highlights the limitations that are inherent in a reductionistic and mechanistic—linear cause and effect based—analysis of complex systems.

Systems thinking and complexity theory attempt to make the leadership and management of actionable problems work efficiently to the best target state possible.

Interconnectedness, unpredictability and uncontrollability are key characteristics of all complex dynamic systems. In dealing with complexity rather than mechanisms, the aim of science shifts from improving our ability to predict and control to better understanding the dynamics and relationships of the systems we participate in so our participation can be more appropriate.

Complexity theory

Dmitri M. Bondarenko and Ken Baskin note the following: "By 1984, the Santa Fe Institute started to bring together thinkers, such as Nobel Prize

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TABLE 1

Differences between systems theory and complexity theory

Systems theory	Complexity theory
From simple to complicated systems.	Complex systems,[1] complex responsive processes[2] and complex adaptive systems.[3]
Ordered systems.	Unordered systems.
Organizational development is the result of plans and actions of management.	All actions and interactions of all are important.[4]
A rather steady state.	Equilibrium dynamics.
Many elements with moderately tangled relationships.	Many actors with relationships that cannot be separated.
Predictable.	Unpredictable.
Causal laws.	Noncausal laws; one can observe the tendency of the system to move in a certain direction.
Models on how the system works.	The only valid model of the complex system is the system itself; it is not possible to construct static models to represent reality, which is multiple, diverse and constantly changing.
Ideal future.	Evolution of the present.
Driven systems.	Modulated systems, movement and direction is important.
Humans are interchangeable widgets.	Humans have agency and multiple identities.
Humans are a part of a stable and homogeneous system that can be fully known through theories. Therefore, they are predictable and form a set that can be controlled through knowledge.	Humans are dynamic, uncertainty is an irremovable part of the human condition.[5] Some types of systems (especially social and natural ones) evolve and create completely new variables and new actors. Peter Allen recently described it this way: "The key step that complexity added was to recognize that the 'system' itself could potentially redefine itself, evolve and change—qualitatively—creating new variables, new mechanisms and new emergent features and characteristics."[6]
It is possible to remain outside a complex system (a business, for example) to better control it.	Observers see themselves as integral parts of the system they observe.
Looking for certainty.	Coping with uncertainty.[7]
Systems thinking will define at the start a target solution and therefore assesses each component, their interactions and the process to achieve the target state.	Complexity theories (such as Cynefin) focus on categorizing the problem space (domain) so the right technique is used in the right context and, most significantly, states the emphasis should be on understanding the current rather than target state and take each step as it comes.
Evidence based.	Acting into the unknown.[8]

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physicist Murray Gell-Mann, computer scientist John Henry Holland and economist Brian Arthur, to study complexity theory. By the early 1990s, the principles of complexity were increasingly being applied to human systems. Today, a variety of organizations are exploring them, from applications in healthcare at the Plexus Institute to organizational work at the Institute for the Study of Coherence and Emergence. In spite of the methodological challenges of applying complexity theory to social sciences, a growing literature has done just that."[15]

Complexity theory was becoming the study of the patterns that emerge as nonlinear, networked systems evolve.

Neil Johnson adopted the definition of "complexity science" as "the study of the phenomena which emerge from a collection of interacting objects."[16] David J. Snowden and Mary E. Boone contributed the Cynefin model.[17] It made a distinction between order and unorder. In an ordered environment, organizations can be simple and complicated. In an unordered context, they are complex or chaotic (see Figure 1, p. 35).

Systems theory deals with simple and complicated organizations, and complexity theory deals with complex organizations. While some talk about complex responsive processes,[18] others call them complex adaptive systems.[19-21]

More and more, the differences between systems theory and complexity theory become clear. See Table 1 for a list of differences.

Systems thinking and complexity do have a lot in common. Where systems theory tries to keep or get control, however, complexity theory accepts the far-from-equilibrium where novelty may emerge. "People jointly create the meaning of what they are doing when they act into the unknown, cocreating their future in interaction with others."[22]

For that reason, Teun W. Hardjono and I even classify them in two different quality paradigms.[23] In our four quality paradigms, systems theory is related to the reference paradigm, and complexity theory relates to the emergence paradigm. The reference paradigm fits with the models and order, strategy and planning (the systems theory perspective) whereas the emergent paradigm requires uncertainty and unorder, improvisation and dialogue (the complexity perspective).

Consequences for quality management and leadership

The acceptance that we (and organizations) often are acting into the unknown and cocreating our future in interaction with others has far-reaching implications for quality management and leadership in organizations. The core of QMSs and the Deming cycle—or plan-do-check-act cycle—might not be effective in a world where long-term planning is less and less possible because of the unpredictability and uncertainty of the future.

Can we plan when the context of tomorrow might be different from today? Or when a virus can unexpectedly threaten our health as well as the economy worldwide? Does it make sense to keep using standards—such as those from the International Organization for Standardization, Joint Commission International or Malcolm Baldrige National Quality Award criteria—when what is right or wrong changes so fast?

Interesting in this regard is the role of leadership. Theory about leadership mostly stems from the reference paradigm and systems theory. In ordered contexts, leadership can sense, analyze or categorize and respond (like the Cynefin-model suggests). In the words of Mary Uhl-Bien, Russ Marion and Bill McKelvey, [24,25] we talk about administrative leadership—leadership grounded in traditional, bureaucratic notions of hierarchy, alignment and control. At its best, leadership also is required to plan improvement and innovation.

In unordered contexts, however, we need another paradigm—the emergence paradigm—and complexity theory. According to the Cynefin model, you can only probe or act, and then sense and respond. Uhl-Bien, Marion and McKelvey[26,27] bring insights from complexity theory on the table. Enabling leadership is needed—leadership that structures and enables conditions in which complex adaptive systems can optimally address creative problem solving, adaptability and learning. Adaptive leadership—leadership as a generative dynamic that underlies emergent change activities—also is needed.

Exploring further through a meta-analysis of complexity leadership research, Donde Plowman and coauthors identify three behavioral processes that co-generate the conditions for new emergent order: disrupting existing patterns of behavior, encouraging novelty and sense-making from patterns and symbols.[28] This kind of leadership is about bringing the right people together, including customers, and facilitating them to cocreate radical innovation. QP

EDITOR'S NOTE

References listed in this article, as well as a bibliography, can be found on the article's webpage at qualityprogress.com.

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