CHAPTER

2

A SYSTEMS PERSPECTIVE OF QUALITY MANAGEMENT: CHARACTERISTICS OF COMPLEX SYSTEMS

Learning Objectives

After completing this chapter you should be able to:

- discuss how a systems perspective can explain recurrent organizational problems;
- define the terms "system," "systems thinking," and "dynamic complexity";
- describe system characteristics that contribute to dynamic complexity;
- identify the influence of dynamic complexity on health services organizations; and
- understand the implications of dynamic complexity on managerial decision making.

As people accumulate years of experience in the healthcare field, they begin to see the recurring problems—sometimes within an individual organization, sometimes across the entire industry. Problems thought to be solved by one manager may come back at a later time for a different manager. The vice president of nursing of a large hospital may centralize and cross-train nurse educator positions to meet necessary budget cuts for the year; three years later, the new vice president of nursing of the same hospital adds unit-based nurse educator positions to address unmet clinical orientation needs of its new hires. Consider the following situation (Georgopoulos and Mann 1962, 549–51):

> The hospital faces a number of problems concerning the nursing staff. . . . one major problem is . . . attracting and retaining a sufficient professional nursing staff, especially non-supervisory nursing staff. . . . [T]he problem lies in the fact that the number of professional nurses being trained in nursing schools is much too low to meet an ever increasing demand for professional nurses by hospitals and other sources. . . . [B]eing understaffed, hospitals often assign to the professional nurse a rather heavy workload that is not seen

> as normal or reasonable by many nurses. . . . [A]nother important problem . . . involves the composition of the total nursing staff, the question of optimum balance in the proportions of staff members who are registered nurses, practical nurses, and aides.

Although this situation may appear to address a manager's current challenges with nursing shortages, the excerpt was taken from the book *The Community General Hospital*, which was published in 1962! During the 60 years since that book was written, health services organizations seem to have made little headway in issues related to workforce planning and management. Nursing shortages, for example, appeared and disappeared in waves in the 1960s, 1970s, 1980s, early 1990s, and again in the early decades of the twenty-first century. Compounding the current nursing shortage is a nursing faculty shortage: "US nursing schools turned away 54,991 qualified applicants from baccalaureate and graduate nursing programs in 2009 due to an insufficient number of faculty" (AACN 2010).

Why do budget problems and workforce shortages remain nagging issues for health services managers? The reasons lie in the complex nature of healthcare, healthcare organizations, and the healthcare industry. In healthcare, as in other industries, "systems thinking is needed more than ever because we are being overwhelmed with complexity" (Senge 1990, 69). Today, one may rephrase Senge's 1990 comment to read, "systems thinking is imperative in health services organizations because they are much more complex than they were in 1990."

Returning to the hospital staffing example, one begins to see how the complexity of professional, financial, and operational drivers of human resources allocation today has increased over time. One example is the impact of generational differences in the workplace. The four generations are referred to as traditionalists or veterans (born 1922–1946), baby boomers (born 1946–1964), generation X (born 1964–1980), and millenials (born 1980–2000) (Houlihan 2007). In health services organizations, generational differences influence the caregiver and the care recipient, and a mismatch between the caregiver's generational communication preferences and care receiver's generational communication preferences can affect the patient's experience and outcomes of care. For example, one manager sought to better understand the influence of generational differences on patient satisfaction in her labor and delivery unit. When the potential combinations of patients and the nurses caring for them were mapped according to their generations (shown in Exhibit 2.1), the complexity of her "simple" question became immediately apparent (Gulliver and Kelly 2009).

Other variables influencing hospital staffing include an aging workforce; the growing proportion of the US elderly population with their accompanying chronic illnesses; cultural diversity and language differences of workers and patients; prevalence of hospitalized patients suffering from morbid

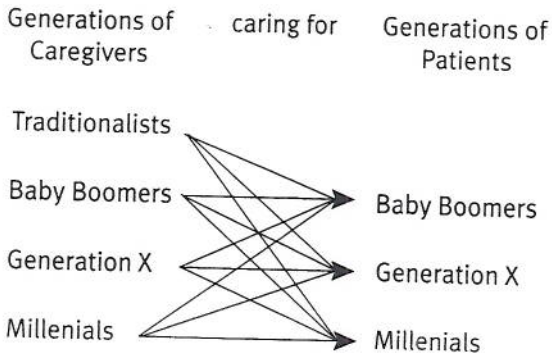

EXHIBIT 2.1 Generational Combinations Between Patients and Caregivers

obesity; clinical and information technology; and emerging infectious diseases such as Methicillin-resistant *Staphylococcus aureus* (MRSA) and H1N1.

When speaking about systems, the term **complex** refers to the presence of a large number of variables that interact with each other in countless and often unpredictable ways. A quick exploration of the generational issue reveals that a single nurse-to-patient relationship expanded to 12 possibilities of generational combinations. This example represents one nurse on one shift with one patient on one unit. Considering the multiple determinants of health and the vast number of components that comprise health services organizations, the possibilities of interaction are mind-boggling. Health and health services organizations are also characterized by situations in which "cause and effect are subtle, and where the effects over time of interventions are not obvious" (Senge 2006, 71). This characteristic represents another type of complexity, known as **dynamic complexity**. In the presence of dynamic complexity, "the same action has dramatically different effects in the short run and the long run . . . an action has one set of consequences locally and a very different set of consequences in another part of the system . . . and obvious interventions produce nonobvious consequences" (Senge 2006, 71). When faced with dynamic complexity, managers must select interventions that alter the fundamental behavior of the system that is causing the problem; otherwise the solution is only temporary. As seen in the nursing shortage example, although interventions may offer temporary relief, the problems resurface again and again.

Complex the presence of a large number of variables that interact with each other in innumerable ways

Dynamic complexity where "cause and effect are subtle, and where the effects over time of interventions are not obvious" (Senge 2006, 71)

This chapter introduces a systems perspective of quality management that is based on the concepts of systems thinking and dynamic complexity.

Systems Thinking

In Chapter 1, a variety of perspectives surrounding the term "quality" are discussed. Likewise, the term "system" brings with it numerous connotations and perceptions. While "system change" is often heard in the quality

and safety discourse, the term "system" may be defined and perceived in a variety of ways. In this book, a **system** refers to a collection of parts that interact with each other to form an interdependent whole (Kauffman 1980; Scott 2003).

System
a collection of parts that interact with each other to form an interdependent whole (Kauffman 1980; Scott 2003)

A system reflects the whole, and "**systems thinking** is a discipline for seeing wholes. It is a framework for seeing interrelationships, rather than things; for seeing patterns of change rather than static 'snap-shots' . . . and systems thinking is a sensibility—for the subtle interconnectedness that gives living systems their unique character" (Senge 2006, 68–69). Systems thinking acknowledges the large number of parts in a system, the infinite number of ways in which the parts interact, and the nature of the interactions. Systems thinking requires that one look for relationships between the elements of a system and seek to understand how they are connected.

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Dynamic Complexity

Several system characteristics contribute to the presence of dynamic complexity (Sterman 2000). Five characteristics, predominant in healthcare and health services organizations, are described in this section: change, trade-offs, history dependency, tight coupling, and nonlinearity.

Change

Systems are dynamic—that is, changing. Change occurs at different rates and scales within and among systems, especially in healthcare. Consider three levels of this characteristic of dynamic complexity in health services. First, the human body changes continuously. This means that key inputs (patients with a clinical problem) to and outputs (patients' status after clinical intervention) of healthcare systems are moving targets. Second, the organizational contexts in which health services are carried out are dynamic in nature. Employees move in and out of organizations, research provides an ongoing stream of new evidence, and technological advances offer new clinical and management approaches. Third, the communities and political environments in which we live and in which healthcare organizations operate change—that is, the environment changes with economic cycles, political ideologies, and election cycles.

Implications for Healthcare Managers

From the day a person is born to the day she dies, she is in a constant state of change, growing and developing physiologically and emotionally. No two human systems are alike or precisely predictable in their response to a medical intervention. As a result, functions that may seem straightforward in other industries, such as product standardization, become more difficult for healthcare managers. For example, the practice of using a standardized list of drug names and brands (i.e., a hospital formulary) to reduce medication

expenses is accepted practice. However, when the dynamic nature of patient physiology is introduced, the manager recognizes that in addition to the question, "What are the set of drug names and brands that will be most cost-effective?" he also needs to ask, "How should the approved drugs be selected, and what are the consequences to patients?"

To aid in grasping the subtle but important nuances involved in individualizing treatment plans, the metaphor of trying on a pair of blue jeans may be used. People have their own favorite brand of blue jeans that "fit," even though another brand may be advertised as having a similar size and style. The formulary essentially dictates to doctors that the patient may buy only slim-cut size 10 jeans and not relaxed-fit size 10 jeans (Kelly and Pestotnik 1998). Research on variations in genetic makeup and the nature of gene–environment interactions promises to shed light in yet unimaginable ways on why certain treatments or medications may work better for one person than another. The emerging fields of **pharmacogenomics** may permit drug selection in the future to be based on an individual's unique genetic makeup, altering the paradigm on which health services organizations manage **pharmacotherapeutics**, "the study of the therapeutic uses and effects of drugs" (Medline Plus Merriam-Webster Medical Dictionary 2011). Preemptive medicine—"removing the initial molecular event—precluding the possibility of that thing even happening" (Culliton 2006, W96)—will likely alter the fundamental role of healthcare delivery organizations in the future.

Pharmacogenomics
"a science that examines the inherited variations in genes that dictate drug response and explores the ways these variations can be used to predict whether a patient will have a good response to a drug, a bad response to a drug, or no response at all" (NCBI 2004)

Pharmacotherapeutics
"the study of the therapeutic uses and effects of drugs" (Medline Plus Merriam-Webster Medical Dictionary 2011)

Trade-Offs

The need to understand the nature of trade-offs may seem unnecessary for managers taught to weigh pros versus cons or opportunities versus risks as they consider organizational decision options. Trade-offs may be seen as an accepted attribute of management. However, an understanding of dynamic complexity fosters an appreciation for the system consequences of local management trade-off decisions. "Time delays in feedback channels mean the long-run response of a system to an intervention is often different from its short-run response. High leverage policies often cause worse-before-better behavior, while low leverage policies often generate transitory improvement before the problem grows worse" (Sterman 2000, 22).

Implications for Healthcare Managers

A classic example of a low-leverage policy was published in the *New England Journal of Medicine* (Fitzgerald, Moore, and Dittus 1988). Although a 1988 publication may be viewed as dated, the lessons for managers in this article are more relevant today than when the study was published.

The advent of prospective payment systems in 1983 drove many hospitals to reduce costs by decreasing patient length of stay. This article examined the effect of these practices on quality of care for elderly patients with hip fractures. As Exhibit 2.2 summarizes, the variables studied included length of

EXHIBIT 2.2 Impact of Low-Leverage Policy: Reducing Hospital Costs by Reducing Hospital Length of Stay

	Before	After
Length of stay	21.9 days	12.6 days
Physical therapy sessions	7.6	6.3
Functional status (measured by distance in feet walked)	93	38
Percentage of patients discharged to nursing homes	38%	60%
Percentage of patients still in nursing homes one year after discharge	9%	33%

Source: Adapted with permission from Table 2 in "The Care of Elderly Patients with Hip Fracture. Changes Since Implementation of the Prospective Payment System" by J. F. Fitzgerald, P. S. Moore, and R. S. Dittus, in the *New England Journal of Medicine* 319 (21): 1394. Copyright © 1988 Massachusetts Medical Society. All rights reserved.

stay, number of physical therapy sessions, functional status measured by the distance in feet that patients could walk, percentage of patients discharged to nursing homes, and percentage of patients still in nursing homes one year after discharge. If a manager in this case defined the healthcare system as "the orthopedic department/unit" or the hospital administrator defined the healthcare system as "this hospital," the intervention chosen to reduce healthcare system costs appeared to be appropriate. In this article, the decision and subsequent interventions to reduce hospital length of stay appeared to be successful; mean hospital stay declined from 21.9 to 12.6 days. In addition, "neither in-hospital mortality nor one-year mortality changed significantly" (Fitzgerald, Moore, and Dittus 1988, 1392). Based on these criteria—length of hospital stay, hospital mortality, and one-year mortality—a manager could be confident that this was a successful cost-reduction strategy.

However, if one defines the healthcare system as including not only the acute phase of care (e.g., orthopedic unit, hospital) but also the downstream providers (e.g., rehabilitation, long-term care) and takes into account how the relationships among all providers influence patient outcomes, the longer-term behavior of the system can be observed. The short-term intervention of reducing hospital length of stay and in turn reducing physical therapy sessions and functional status also led to an increase in patients discharged from the hospital directly to nursing homes. The authors concluded that the result was a shift in "much of the rehabilitation burden to nursing homes" (Fitzgerald, Moore, and Dittus 1988, 1392), and they observed a subsequent increase in the percentage of patients remaining in nursing homes one year after hospital discharge. Overall costs related

to the consumption of healthcare resources for the care of these patients actually increased.

To this finding, a manager may respond, "But my responsibility is only my unit/hospital." From a systems perspective, the acute care manager is responsible not simply for the acute care unit or hospital but also for the effect those local decisions have on the rest of the system of which the manager's component is a part. This does not mean that the manager of the orthopedic department or the hospital administrator should not strive to reduce hospital costs. It does mean, however, that managers, financial officers, CEOs, and policymakers should be aware of how decisions made and implemented within their domains of responsibility affect other parts of the healthcare system, positively and negatively. When a negative impact to another part of the system is anticipated, the manager should be proactive in the short term to help minimize the negative effects and preserve positive patient outcomes. In the case presented in this article, a proactive intervention would have been to ensure that nursing homes had adequate rehabilitation capacity before reducing hospital length of stay. These challenges have been addressed over the years and are seen today in improvements to post-acute care, strengthened relationships between acute care and skilled nursing facilities (SNFs), and the emergence of the concept of **accountable care organizations** (ACOs).

Accountable care organization (ACO) an organization through which groups of providers share responsibility for providing care (Gold 2011)

Other common trade-off challenges for healthcare managers surround the differences between expense and investment decisions within organizations and departments. The long-term effect of a manager's short-term decision may not be felt by another component in the system (e.g., nursing home, patient) as in the previous example, but perhaps it will surface at a certain point in the future within the manager's own department or organization. For example, does the manager sacrifice capital improvements to fund agency workers in the short term? Do managers reduce staff education dollars to reduce current expenses? Although choosing agency workers and reducing staff development activities may meet the short-term need to reduce expenses, these efforts fall into the category of low-leverage policies because the problems of facility aging, staff shortages, and the need for a competent workforce will surely be faced by the manager in the future. Without an appreciation of system consequences, one manager may be rewarded for the short-term "success" with a promotion, while his successor inherits the longer-term problem.

In the formulary example, the organization may be willing to trade the rare adverse medication event for dollar savings realized from product standardization. However, this type of micro (patient level)/macro (organizational level) trade-off that allows for patient status to be potentially compromised may unintentionally contribute to polarization and conflict between clinicians and managers.

History Dependency

Systems are history dependent. In other words, what has happened in the past influences what is occurring in the present. Some actions are reversible, but many actions are not.

Implications for Healthcare Managers

History dependency may be seen in the patient and the organization. Due to advancements in care of chronic illnesses, rather than succumb to complications of one illness, elderly adults are often under treatment for several chronic illnesses concurrently. Persons with cystic fibrosis or born with congenital heart defects now enjoy a life expectancy into adulthood; previously these conditions usually were fatal in childhood. Unhealthy behaviors, such as excessive alcohol, drugs, or cigarettes, even when discontinued, may have long-lasting health consequences. Understanding a patient's history is not only important for clinical providers, but also is important for health services managers. For example, a patient's health history influences resources required for his care. An obese patient being treated for asthma, hypertension, and diabetes requires more labor-intensive care when having his gallbladder removed than an otherwise healthy athlete undergoing the same surgery. In recognition of these differences, clinical outcomes analysis requires adjustments for patient acuity (e.g., presence of comorbidities) and definition of an organization's overall patient acuity (e.g., case mix index [CMI]) (Iezzoni 2003). Such analytic tools take into account the patient as a dynamic system and permit comparison of outcomes between different patients and institutions.

Another example of this characteristic is how a healthcare organization's past decision to pursue or not pursue electronic information systems affects its ability to meet current information demands and reporting requirements. The ability of the healthcare industry to manage information and report performance pales in comparison to that of other industries, such as financial services. Consider the following perspective: "If you go to the doctor, the doctor is recording your visit in vegetable pigment on crushed wood fibers. This is literally a medieval method of data storage and retrieval. I ask you, how would you react if you went to a bank and asked for money and someone opened up a big, old ledger and blew it off and said, 'Oh, let's see, how much do you have?'" (Smith 2002).

The manager must realize not only how past events have shaped current events but also how past decision-making strategies and directions may influence her ability to successfully achieve current and future goals. Using the information systems example, if the organization has historically rewarded managers for quarterly or annual financial performance, a large capital investment today for a future financial gain may be difficult to sell given the reward and decision-making history of the organization.

Tight Coupling

A system is characterized as **tightly coupled** when "the parts exhibit relatively time-dependent, invariant, and inflexible connections with little slack" (Scott 2003, 358), as in elegantly crafted configurations of dominoes that are set in motion by a push to the first piece. Tight coupling is also present when "the actors in the system interact strongly with one another" (Sterman 2000, 22).

Tightly coupled when the parts of a system "exhibit relatively time-dependent, invariant, and inflexible connections with little slack" (Scott 2003, 358)

Implications for Healthcare Managers

Organizations in industries outside of health services that are most commonly identified as tightly coupled include nuclear power plants and aircraft carriers (Roberts 1990). Health services, however, are not contained within a single organization; rather, services are provided by a complex variety of interdependent organizations (i.e., social structures; see Chapter 1). Within these organizations, nested structures such as departments, divisions, and professional groups are also present. Social organizations are generally considered to be "complex and loosely coupled" (Scott 2003, 83); however, the tasks carried out by the organizations may often be considered tightly coupled. For example, surgeons, anesthesiologists, and nurses may belong to separate, distinct, loosely coupled departments within the structure of the organization, yet, when they come together in the operating suite, the tasks involved in conducting a surgical procedure are tightly coupled. An undetected mistaken patient identity or incorrect surgical site can quickly lead to disastrous consequences if not identified prior to surgery.

Tools such as the World Health Organization Surgical Safety Checklist are intended to align the loosely and tightly coupled parts of the system to promote safe clinical outcomes in any surgical setting with any team of providers. This tool specifies the items that must be verified and who must verify them prior to three key phases of the surgical procedure: at anesthesia induction, at incision, and when the patient leaves the operating room (WHO 2010). Likewise, immediately placing identification on newborns, especially with multiple births, is standard practice. Consider twins whose identification bands are accidentally switched at birth. The twins subsequently could receive multiple inappropriate treatment orders as all diagnostic results and other documentation are mistakenly applied to the wrong baby.

Numerous interactions within and between people, processes, and departments within individual organizations and interactions among services along the continuum of care require managers to be attentive to the concept of coupling. Identifying, designing, and institutionalizing tools that promote task alignment, communication, collaboration, coordination, and strengthened relationships among the players are required competencies for contemporary health services managers.

Nonlinear
the "effect is rarely proportional to the cause" (Sterman 2000, 22)

Nonlinearity

The term **nonlinear**, as it refers to a system characteristic, means that the "effect is rarely proportional to the cause" (Sterman 2000, 22) and that, because the parts in the system may interact in numerous ways, these interactions may follow "unexpected sequences that are not visible or not immediately comprehensible" (Scott 2003, 358).

Implications for Healthcare Managers

A nurse just starting the afternoon shift is the object of an outburst of anger from a patient's family. The nurse relates the encounter to a colleague at the nurse's station: "All I did was say, 'Hello'!" This situation may bring to mind the old cliché "the straw that broke the camel's back." In fact, this cliché is an accurate description of the encounter.

The patient and her family had accumulated a sequence of unsatisfactory experiences during the hospital stay, so all it took was one more encounter to trigger their anger. Although this was the first time the afternoon nurse had met the family, his was the last in a series of interactions between the patient and the healthcare system that caused this family grief. Now, if the patient complains to the manager about this nurse, what can the manager do? If the manager does not have an appreciation for the nonlinear nature of systems, she may be tempted to discipline the nurse. However, if the manager does have an appreciation for the nonlinear nature of systems, she may try to re-create with the family the sequence of events. Although each event was relatively harmless considered individually, when linked together with the family's situation they contributed to a dissatisfying experience. From this investigation, the manager may identify areas that can be improved to enhance the patient's overall experience with the care-delivery process.

Another example of the nonlinear nature of systems may be seen in strategies used to reduce personnel expense in healthcare organizations. Because personnel expenses make up such a large percentage of operating budgets, changing the staff mix—that is, reducing the number of professional staff (e.g., registered nurses, medical technologists, pharmacists) and increasing the proportion of assistive personnel (e.g., nurses' aides, laboratory assistants, pharmacy technicians)—is a common cost-cutting intervention. When this intervention is studied from a systems perspective, however, the resulting sequences of activities and their interrelationships are more readily seen. The unplanned consequences of this cost-cutting strategy in one organization included an increase in the overall employee turnover rate because of the high turnover among the entry-level, assistive personnel group. Because this cost-cutting strategy was used by managers across different types of professions and departments, the stress and cost of continuously recruiting, hiring, and training new employees more than offset the savings hoped for from lowering the average hourly wage. When viewed from one department's point of view, the cost-reduction strategy may appear to be reasonable;

however, when the compounding effect of this cost-cutting strategy is viewed across the entire organization, the strategy designed to reduce costs actually undermines the organization's ability to do so (Kelly 1999).

Summary

Like the term "quality," the term "system" can carry a variety of connotations. In this text, a system refers to a collection of parts that interact with each other to form an interdependent whole, and systems thinking acknowledges the large number of parts in a system, the infinite number of ways in which the parts interact, and the nature of the interactions. The five system characteristics contributing to the presence of dynamic complexity are change, trade-offs, history dependency, tight coupling, and nonlinearity.

Exercise

Objective: To practice identifying dynamic complexity.

Instructions:
Describe how the following examples illustrate dynamic complexity.

Example 1:
"Hurricane Katrina devastated economies, communities, families and individuals along the US Gulf coast in 2005. Although the levees in New Orleans were known to be vulnerable (Fischetti 2001), policymakers chose *not* to invest the resources needed to strengthen them. The failure of the levees and the flooding that followed have led to the most expensive urban recovery and rebuilding effort in US history. Federal dollars that now must rebuild the shattered coast are no longer available to fund daycare centers, school lunch programs, Medicaid or nursing research. People fleeing from the Gulf coast evacuated to communities throughout the United States. On arrival in places such as Atlanta and Houston, they needed health services and replacement of essential prescription drugs—and most had no health records or insurance information . . . documents that would normally be essential."

From: Mason, K. D., J. K. Leavitt, and M. W. Chaffee. 2007. "Policy & Politics: A Framework for Action." In *Policy & Politics in Nursing and Health Care*, edited by K. D. Mason, J. K. Leavitt, and M. W. Chaffee, 1–20. St. Louis, MO: Elsevier.

Example 2:
"Hospitals nationwide are tangling with Wall Street to get out of disastrous wages that have complicated their financial problems. Some hospitals are paying millions of dollars in penalties to get out of derivatives contracts, after betting incorrectly that interest rates would rise. Other hospitals are paying

higher interest rates. At many, these ill-fated financial bets have contributed to layoffs and scuttled projects. More than 500 nonprofit hospitals—at least one in six—bought interest-rate "swaps" to lower their borrowing costs . . . the swaps allowed hospitals to act much like homeowners switching from a floating-rate mortgage to a fixed-rate one, betting on rising interest rates . . . these bets backfired when the Federal Reserve cut interest rates to nearly zero from more than 5% in 2007. . . . Financial engineering by Wall Street has been a huge part of hospitals' problems and has even translated into a lack of hospital beds."

From: Dugan, I. J. 2010. "Wrong-Way Financial Bets Have Hit Hard." *The Wall Street Journal*, July 10.

Companion Readings

Association of Academic Health Centers. 2008. "Out of Order Out of Time: The State of the Nation's Workforce." Washington, DC: Association of Academic Health Centers. [Online article; retrieved 1/17/11.] www.aahcdc.org/policy/AAHC_OutofTime_4WEB.pdf

Coutou, D. L. 2003. "Sense and Reliability: A Conversation with Celebrated Psychologist Karl E. Weick." *Harvard Business Review* 81 (4): 84–90.

Senge, P. M. 1990. "The Leader's New Work: Building Learning Organizations." *Sloan Management Review* (Fall): 149–65. (Note: This a classic article and has been reprinted in 1998 and 2006.)

Weick, K. E., and K. M. Sutcliffe. 2001. *Managing the Unexpected: Assuring High Performance in an Age of Complexity*, 1–23. San Francisco: Jossey-Bass.

Web Resources

Applied Systems Thinking: http://appliedsystemsthinking.com/
New England Complex Systems Institute (NECSI): www.necsi.edu/about/
Society of Organizational Learning: www.solonline.org/
System Dynamics Society: www.systemdynamics.org