A Complex Systems Framework for Research on Leadership and Organizational Dynamics in Academic Libraries
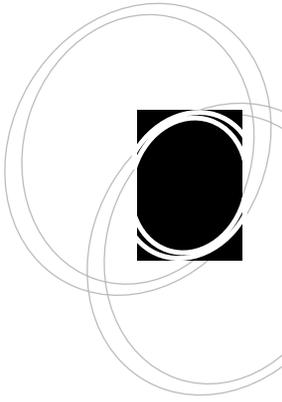
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abstract: This article provides a historiographical analysis of major leadership and organizational development theories that have shaped our thinking about how we lead and administrate academic libraries. Drawing from behavioral, cognitive, systems, and complexity theories, this article discusses major theorists and research studies appearing over the past century. A complex systems framework is then proposed for future research on leadership and organizational development surrounding change in academic libraries and professional responsibilities.

Introduction

In 2002, this journal was nearing the end of its second volume. The editor challenged our profession to ask, "When's this paradigm shift ending?" In order to answer this question, Charles B. Lowry performed a recursive history, weaving together the major impacts on academic librarians during the course of a century and a half.[1] Granted, we have probably seen some of the most significant of these changes take place in our libraries over the past 20 years as a result of digital and networked technologies, but Lowry's challenge to us all was to examine our environments and determine whether current practices and structures were suited for future development.

In a similar vein, many of the activities involved with transitional and even transformational phases of our profession draw from a legacy of leadership and organizational development (OD) theories and research that have evolved over the past century. Several researchers have argued that these subjects imply dynamic processes that contain simul-

taneous and sometimes competing or conflicting phenomena. In their view, therefore, it is often hard to narrow acts of organizational interaction or leadership into one theory, since there are many variables that come into play during these processes.[2] Moreover, there are several books that come out almost weekly in the popular literature on leadership and organizational development that discuss the problems with the research framework. Consequently, this article includes a strong theoretical framework on leadership and organizational development as a basic foundation of scholarly research. The purpose of this research, therefore, is to provide a historiographical analysis of major leadership and organizational development theories while including research studies that support the administration and evolution of academic libraries. Moreover, in helping to further address Lowry's original question, this article develops a research framework for understanding change by viewing our organizations as complex systems.

Although it is common to see the terms management and leadership used interchangeably in the popular literature on organizations, there is a distinct difference in the use of the term leadership in this article. Paul Hersey and Kenneth Blanchard suggest that management is "the process of working with and through individuals and groups and other resources to accomplish organizational goals."[3] Leadership in their view, however, conveys a much broader meaning, relying on the reoccurring concept of "organization." They define the term leadership as occurring "any time one attempts to influence the behavior of an individual or group, regardless of the reason. It may be for one's own goals or for those of others, and they may or may not be congruent with organizational goals."[4] Therefore, the concept of leadership is symbiotically connected to organizational development. Moreover, meta-analysis of leadership and OD research implies the study of change—or, more accurately, continuous change—something with which we are all familiar in academic libraries in recent years.[5]

When trying to understand the phenomena that surround academic librarians experiencing change, it is important to note, first, that there is a long history of both leadership and OD practices that focus on the works of Frederick Taylor. His theory of scientific management, focused on the clear division of labor, led to an emphasis on efficiency, and tended to view humans much like machines. Through the use of deductive reasoning, scientific managers, in theory, could reduce a job task to a prescriptive amount of time for completion and could identify a single way to complete these tasks most efficiently.[6] Although the theory was met with resistance from Taylor's contemporaries,[7] organizational theory throughout the remainder of the century struggled to move beyond this frame of reference and incorporate more humanistic approaches. In fact, it is still common to see aspects of scientific management theory in institutional and library mission statements, policy documents, and procedures manuals. This suggests that scientific management maintains a strong grasp on the value and belief systems of some twenty-first century higher education institutions; and, consequently, its focus on reductionism is at odds with the concept of organizational development.[8] In the following sections, several leadership and OD theories will be discussed historically to assess the current state of theory and its impact on our profession.

Behavioral and Cognitive Theories of Leadership and Organizational Development

Theory X, Theory Y, and Theory Z

> And the general public, business leaders, and politicians are left with the implication that mankind is an unorganized rabble upon which order must be imposed.[9]
>
> *Elton Mayo (The Rabble Hypothesis)*

The first commonly developed theories of leadership focused on behavioral and trait aspects of leaders and followers. Douglas McGregor and Chris Argyris developed almost concurrently the earliest theories of leadership and OD that break from the scientific management belief systems of the early twentieth century. McGregor's Theory X was a description of the Rabble Hypothesis and subsequent common managerial beliefs: followers typically do not like to work, do not want responsibility, and prefer to be directed. However, just as with Theory X, "it was not until the development of the theory of relativity during the present century that important inconsistencies and inadequacies in Newtonian theory could be understood and corrected."[10] As a result, McGregor contended that there was a growing body of evidence that contradicted this view of human motivation in the work place.

Theory X deals largely with transactional and contingent reward approaches to leadership. Conversely, Theory Y focuses on the creation of an integrated environment, emphasizing relationship building that fosters self-directed learning and creativity in problem solving. William Ouchi added to the evolution of Theory X and Y organizational development in his work *Theory Z*, in which he compared Japanese with American business cultures. He found that American organizations have a tendency to promote fields of specialization, and career moves are typically made externally within the same field. These employment paths are equally typical in academic libraries. Conversely, in Japanese firms, employees move between jobs within the same firm, gaining new knowledge in a different area with each transition. Moreover, in decision-making, emphasis is not placed on consensus but rather on the employees' levels of being informed about the decision and their commitment to it.[11]

Normative and Transactional Theories of Leadership and Organizational Development

The attribute theory of Robert Blake and Jane Mouton is perhaps the most widely known behavioral theory in leadership and OD research. They contended that effective and ineffective leadership styles could be plotted at specific areas of a quadrant grid in relation to the leader's concern for institutional performance and concern for people. In a different framework, Blake and Mouton's normative decision model shows how individuals within groups succumb to group pressures to conform and converge toward the formation of group norms. Equally, this convergence is manifested more in emotional and behavioral responses than on assessment of data that would lead to effective decision-making. This is at the root of some of the problems that surround orga-

nizational conflict and resistance to change.[12] The library science literature describes this phenomenon as psychological contracts; "these are the unwritten (and often unspoken) *understandings* held by individuals about expectations, privilege, power, obligations, rewards, and the like."[13]

Burns is perhaps most commonly cited on transactional, or power-influence, theories. He discussed in great detail the use of power in political and cultural situations, incorporating several historical analyses of significant leaders. Burns contended that transactional leadership relies on the concept of reciprocity, a give and take relationship between leaders and followers in which leaders must realize that their power can quickly diminish if the needs of followers are not met and vice versa. Transactional leadership theories cannot be discounted, as Bruce Avolio, Bernard Bass, and Gary Yukl have argued, and any process of leadership contains the potential for both transactional and transformational approaches. In some situations, these researchers contend, both transactional and transformational theories can actually complement one another.[14]

Behavioral and Normative Studies in Academic Libraries

Peter Hernon, Robert Powell, and Arthur Young have performed two of the most comprehensive studies on phenomenological and behavioral aspects of leadership associated with research library deans. In their first study, Association of Research Libraries' (ARL) deans saw their positions shifting from internal to external foci, higher attrition rates, more emphasis on leadership experience while continuing to focus on academic qualifications, and the ability to manage conflicting expectations among the university community. Equally, several deans stated that their jobs were becoming so much more complex that many of their previous job duties were now being shared with other library administrators and staff. In their second study, which included ARL deans and associate and assistant deans, the large numbers of expected attributes they presented perhaps reveals a critical juncture in behavioral theories.[15] As an example, one ARL director commented that this behavioral theoretical framework had become unrealistic for research on library leadership:

> If you look at the studies that Peter Hernon has been doing about the responsibilities of a contemporary research library director, there are somewhere around 140 attributes that make you a successful leader in research libraries. Nobody can do all of these things.[16]

Although these studies do not incorporate the multi-dimensional aspects of effective leadership processes in complex organizations but focus primarily on behavioral theory, they have provided some of the most comprehensive and needed research on critical attributes for future library leaders.

Marie Kascus also conducted research on the leadership of teams at an ARL institution by measuring behavioral traits that identified the shift from management to leadership roles and the success of this strategy. Six main leadership traits were measured, looking for causal relationships in the success of teams. Equally, she assessed the effects of organizational change in relation to the needed leadership attributes of team leaders through the perspectives of team members, senior managers, and team leaders.[17]

David Dowell's research on perceptions of leadership in academic libraries expands on behavioral theory. Dowell found, most notably, that within large academic libraries

sexism existed "on both sides of the gender gap."[18] Samples of both women and men showed that participants tended to list their sex at higher rates as defining leadership attributes than either sex was represented as a percentage of the intra-organizational populations. However, as the questions shifted to external foci, such as peer and professional networks, this sexism began to diminish. In concluding the study, Dowell showed that leadership was viewed in a variety of ways, depending on social and structural contexts; and, many times, the designations of leaders were outside of the typical administrative structures of the organization.[19]

Transformational Leadership and Organizational Development Theories

Burns strove to define leadership as something more than transactional, arguing that its ultimate goal must be to eventuate social or organizational change. Therefore, leadership must evolve toward transformational attributes that encourage followers to find purpose beyond individual wants and needs while searching for collective transformation of the organization through their interaction and learning with others.[20] Bernard Bass' research expands on the importance of transformational leadership. The combination of the Multifactor Leadership Questionnaire and the Organizational Description Questionnaire measures leadership attributes against follower perceptions of leadership based on both transactional and transformational characteristics. Additionally, Bruce Avolio and Bernard Bass' case study research showed that, in organizations with cultures that are either transactional or transformational, individuals would validate the dominant culture through positive scores and invalidate the sub-dominant culture with negative scores. However, transformational leadership tended to receive higher scores overall. As Avolio and Bass' studies have shown, there is a high correlation between subordinate ratings of leaders in relation to their transformational attributes.[21] Additionally, Boas Shamir, Robert House, and Michael Arthur's self-concept based theory addresses how charismatic leadership influences behavior and individual self-concepts of social values, motivation, esteem, and defense mechanisms.[22]

Transformational Studies in Academic Libraries

Very few research studies on transformational leadership exist in the library science literature. However, Rosie Albritton performed a comparison study of leaders and followers in medium-sized academic libraries to test the efficacy of Bass' Multifactor Leadership Questionnaire. Of the 146 participants in the survey, correlation analysis showed significance ($p<.01$) for transformational attributes contributing to perceptions of successful leadership outcomes among followers.[23] Equally, peer mentoring, as an aspect of organizational learning, has been encouraged by Mary Ann Mavrinac as a critical component of transformational leadership in academic libraries.[24]

> **Very few research studies on transformational leadership exist in the library science literature.**

Contingency and Situational Theories of Leadership and Organizational Development

Fred Fiedler first championed contingency theory as a method for designing organizations and subsequently responding to them effectively. Contingency theory relies on a number of variables that work in coordination and contrast with one another such as task and organizational structures and relationships.[25] However, Fiedler's contingency theory has received mixed reviews in its effectiveness as an assessment method, primarily as a result of specification bias and replicable validity in quantitative analysis of variables under study.[26] Despite this, contingency theory has evolved into more discrete areas that help to explain specific aspects of leadership and organizational dynamics.

Situational theory responds to many of the shortcomings of contingency theory and has been most highly developed through the work of Paul Hersey and Kenneth Blanchard. This model relies on a number of contextual factors that take into account leaders' task and relationship behaviors vis-à-vis the readiness and willingness levels of the follower or group. Task behaviors are described as the amount of direction a leader gives to employees, whereas relationship behaviors describe the level of socio-emotional interaction the leader exhibits with followers. They describe the readiness levels of followers based on their motivation, knowledge base, and the experience needed to achieve individual and group goals.[27] Consequently, it becomes apparent how this model can take into account balancing the regard for organizational effectiveness while recognizing the need for human satisfaction in Theories Y and Z.

Contingency and Situational Studies in Academic Libraries

> **Situational theory shows promise as a framework for understanding and developing the academic library of the future.**

To date, few research studies on contingency theory exist in the library science literature. As was stated previously, however, problems in methodological application may contribute to this absence. Perhaps most closely associated is Gregory Crawford's contingency study of 400 liberal arts colleges and the use of technology. As a cause and effect study, Crawford showed that there was not support for the use of contingency theory in generating a framework for understanding how technological changes lead to leadership behaviors.[28] Conversely, situational theory shows promise as a framework for understanding and developing the academic library of the future. The library science literature shows anecdotal research on situational leadership, at best; however, it has been studied in detail in the broader social and behavioral sciences literature.

Shared Leadership and Systems Theories of Organizational Change

Shared Leadership and the Team Approach

Shared leadership theories have received much greater attention in the library science literature over the past 20 years and include such concepts as participatory and demo-

cratic management. Peter Senge is perhaps most commonly cited in academic library organizational development research for his work on the team-based environment of shared leadership, arguing for more natural organizational structures that foster group learning. In his opinion, the team-based structure consequently responds to a more rapidly changing external environment, and factors such as shared visioning and group learning are difficult to achieve in bureaucratic organizational structures.[29] Donald Carew, Eunice Parisi-Carew, and Kenneth Blanchard's Situational Leadership II model places more emphasis on understanding group dynamics than on individual behaviors in a team approach to shared leadership. Although the authors have found positive correlations between increased leadership direction and structure during early stages of a change process, a shift toward participative and supportive leadership behaviors must take place at later stages of the change process in order to sustain high levels of group performance.[30]

Gary Yukl called attention to shared leadership through his analysis of several different types of organizational teams. He cited numerous companies in the private sector that had incorporated team-based organizational structures to some degree, noting how teams vary in their composure and charge. Yukl emphasized the role of self-managed teams over functional and cross-functional teams, because self-managed teams have much more autonomy and have a larger capacity for group learning. However, similar to the organizational dynamics problems encountered by other researchers,[31] Yukl argued that "giving authority to a self-managed team rather than to an individual leader does not necessarily result in collective feelings of empowerment. The team may replace an autocratic supervisor with social pressure on members to conform to group norms and procedures."[32]

Studies of Shared Leadership and Teams in Academic Libraries

Much has been written on the study of team-based organizational structures in the library science literature. Shelley Phipps and Jeanne Voyles have written about the impact of the team approach as a response to the rapidly changing environment, noting the importance of flexibility in decision-making in the team process. The University of Arizona Libraries have additionally been hosting the bi-annual "Living the Future" conference since 1996 with this year's featured speaker being Peter Senge.[33] The University of Connecticut Libraries have also participated extensively in research on teams, ranging from Kascus' study of effective team leadership behaviors to David Garnes and Susan Smith's longitudinal study of extending the team environment through communication with the campus community.[34] Equally, Kathryn Loafman and Rosann Bazirjian and Nancy Markle Stanley wrote on the effectiveness of participatory management processes in teams at Oregon State University and Pennsylvania State University Libraries, respectively, after restructuring activities.[35] This author additionally identified advantages and challenges to a team-based environment in his study of the "East Coast University Libraries" (a pseudonym); and M. Sue Baughman and Neal Kaske, as well as Charles B. Lowry, have written on the experiences of the team-based structure within an organizational learning environment at the University of Maryland Libraries.[36]

Systems Theories of Organizational Change

Systems theories have come to play an increasingly important role in the study of organizations and, in particular, academic libraries. During the middle of the twentieth century, Kurt Lewin challenged mainstream approaches to psychological analysis through the creation of field theory, borrowing from contemporary physics. Modeling a process of unfreezing, moving, and refreezing of group standards, Lewin argued that this field view was necessary to move individuals within groups from the perspective of a "goal to be reached" toward a view of change that moved the group "from the present level to the desired one."[37] Around the same time, Ludwig von Bertalanffy expanded research in the biological sciences and opened the door for an organic view of organizations in his *General System Theory*.[38] In effect, his work developed at a time when many researchers had started investigating evolutionary and natural approaches to studying human interaction as an alternative to the reductionist theories that viewed the individual as a discrete whole, thereby limiting the macro view of the organization.

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Russell Ackoff extended this systems theory approach, arguing for interactive planning models in organizational theory. In his view, organizational change is a never-ending process, yet humans desire organizational stability, which he compared to the biological concept of homeostasis. The increasing complexity of organizational life and the tension between individual and organizational concerns led Ackoff to argue for a new, nonlinear systems view. The interdependence of individuals in an organization leads to increases or decreases in internal variability, thereby promoting or inhibiting system development.[39] Donald Schön focused on systems theory during the process of change in organizations. He noted that turbulence forces individuals to move away from an equilibrium-oriented environment: "The crisis forces vital elements of the system to change. The change threatens disruption at the stable state whose achievement and maintenance are central to the existence of the organization."[40] However, individuals within the organization eventually recognize the existence of the crisis, which places them in a position to transform the organization internally through the creation of new ideas, known as *reflection in action*.[41]

Chris Argyris and Donald Schön have collaborated on research and writing,[42] extending this view of organizational dynamics in relation to action in a later shift in focus to Model I and Model II OD theories. They found that single-loop learning is a dominant function of organizational learning; "members of the organization respond to changes in the internal and external environments of the organization by detecting errors which they then correct so as to maintain the central features of organizational theory-in-use."[43] In other words, single-loop learning reinforces the culture and belief patterns that already exist in Model I organizations.

Double-loop learning extends the learning process of simple error correction and reflects on the organizational processes that cause error. As a result, double-loop learning

challenges organizational norms and behaviors by studying the conflicts of individual "theories-in-action" and by creating new theories. Finally, drawing from the work of Gregory Bateson on deutero-learning, second-order learning incorporates both single and double-loop learning.[44] It challenges group members to learn about the previous contexts of their learning and how these have influenced their knowledge activities. Consequently, second-order learning posits core theory creation within the organization by learning *how* to learn.

In systems theory, this concept of the learning organization has been attributed primarily to Senge in the library science literature. Senge's learning organization theory, heavily influenced by the works of Argyris and Schön, is composed of five main disciplines: personal mastery, mental models, shared vision, team learning, and systems thinking. The fifth discipline, systems thinking, is the foundation of the learning organization and provides a framework for integrating the four other disciplines. Senge contended this systems view provides a way for individuals to see the organization as an interconnected, living organism within an environment that responds to reinforcing or controlling feedback mechanisms.[45] Robert Flood and Peter Checkland expanded on the field of systems theory through prismatic OD and soft systems methodology.[46] As a result of "soft problems" in the social sciences, in which goals and objectives are difficult to prescribe during problem-solving situations, soft systems methodology subsequently "emerges from the research experience as a systems-based means of *structuring a debate*, rather than as a recipe for guaranteed efficient achievement."[47]

Finally, Jay R. Galbraith has written extensively on the development of the matrix organization within systems theory. Its most pronounced difference from many other organizational structures is the distribution of authority along both functional and project lines. In this model, which has predominantly been used in engineering and computer science organizations, staff typically have supervisors who correspond to each area and task and who, in theory, integrate leadership and OD toward a dimensional matrix and away from a linear structure. Equally, the design of the matrix organization helps fuse the traditional hierarchical roles, with which many of us in academic libraries are familiar, with the loose coupling of the team-based environment while addressing issues of accountability in group leadership.[48]

Systems Studies of Academic Library Organizational Change

Systems theory has been studied in library science throughout the second half of the twentieth century. Implicitly, librarians have somewhat "stumbled" upon this theory through the course of natural descriptions of their libraries, regardless of organizational structure. Ideas such as learning organizations, quality improvement, learning circles, and distributed processing in academic libraries draw from the theoretical foundations of systems theory, yet many of us may be unaware of how this theory influences our organizations. Explicitly, S. R. Ranganathan first called for a systems approach, arguing that the organic nature of libraries was impossible to avoid.[49] In a major organizational analysis of Association of Research Libraries, Duane Webster drew heavily from OD theorists such as Argyris and Schön in an explanation of existing dysfunctional organizational patterns and assessment methods.[50]

More recently, Phipps' study of a systems design of OD in a research library brings new insight to a theory of integration that incorporates aspects of systems theory and continuous quality improvement. Responding to aging organizational structures and work processes, a new nonhierarchical structure that focused on technology to perform new work functions was then introduced in the library.[51] In a similar framework, Amos Lakos and Shelley Phipps described the need for systems-based assessment in academic libraries involved in rapid change.[52]

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Although the matrix organization might be one successful approach to integrating a team-based structure within the traditional structures of academia, only two institutions have reported research findings with any depth.[53] Additionally, soft systems are studied with frequency in Canadian, United Kingdom, and Australian libraries,[54] but the theory appears to be absent from the library science literature pertaining to OD in the United States.

A Complex Systems Framework for Research on Academic Libraries

Discussion on Current Theoretical Frameworks for Library Research

Perhaps one of the earliest theories of library OD can be traced back to Ranganathan. He developed a model, based on evolutionary biology, describing the *Five Laws of Library Science*.

> It is an accepted biological fact that a growing organism alone will survive. An organism which ceases to grow will petrify and perish. The Fifth Law invites our attention to the fact that the library, as an institution, has all the attributes of a growing organism. A growing organism takes in new matter, casts off old matter, changes in size and takes new shapes and forms.[55]

Ranganathan's views were critical to the evolution of library science, and he is still cited in the literature today. However, a disconnect between theory and application appears to remain in many academic libraries.

During the last 20 years, the rise of networked information and resources has led to a renewed interest in reframing library leadership and OD. Charles Schwartz has focused on the impact of technological change and how this necessitates re-thinking library OD in the future. Maureen Sullivan and Barbara Allan have integrated action research methods and experiential learning into the process of OD. Joan Giesecke has shown how OD can emerge in mentoring opportunities for new supervisors, and David Kohl has emphasized how the breakdown of traditional physical places and items changes the organizational structures and dynamics of academic libraries. Equally, ARL institutions have participated actively and publicly in furthering the discussion on OD,

and several ARL publications have provided case studies on these issues.[56]

From a theoretical perspective for future research, Denise Stephens and Keith Russell synthesized contemporary literature in an attempt to recreate, or ground, a theory of library OD that brings the evolving practices of librarians in a changing environment into account. They contended this focus requires the use of organizational and leadership theories that are outside of library science, as professional traditions are often too engrained within the research framework. Stephens and Russell followed in the same path as Ranganathan, suggesting that libraries are constantly changing at a very fast rate or, rather, undergoing metamorphosis. Consequently, librarians now require organizational models that focus on adaptation to the environment. They argued that librarians cannot divorce themselves from the conflicting views of OD, change, and leadership and, therefore, should embrace them concurrently.[57] Karen Holloway furthered this view of OD, championing systems and quantum theory interpretations of libraries that consist of non-linear, change-oriented processes. In her interviews with librarians and library administrators, she noted that successful changes rely on "balancing the competing values in an organization," echoing Morgan's focus on competing tensions in organizations.[58] In effect, turbulence within the system, combined with an environment that fosters group development, leads to the potential for self-organization to emerge among librarians.

As James G. Neal noted, "Higher education libraries are advancing away from the traditional or industrial age library, a model that is no longer viable."[59] Consequently, a current challenge to research on leadership and organizational dynamics in academic libraries is to develop a strong theoretical framework for future studies. Although behavioral theories are still—and will most likely remain—foundations for theoretical construct development in library science research, this article suggests that new methodologies and epistemologies will be needed that enhance, extend, and even supercede previous research. As an example, assessment and organizational practices in academic libraries, and in colleges and universities in general, have primarily focused on input measures for nearly a century.[60] However, most recently ARL has moved from the input measures found in the Membership Focused Index to the output metrics of the Library Investment Index.[61] Equally, for higher education in general, regional accrediting agencies and national organizations have already implemented systems-oriented and leadership-focused output methods that integrate a more holistic view of institutions rather than reducing academic units to discrete areas. Consequently, in an era of rapid change and organizational transformation in libraries, it becomes more difficult to integrate leadership and OD models of slow, linear, and disconnected transitions. Therefore, it would seem to be a natural, if not evolutionary, progression that research on leadership and OD begin to incorporate the study of academic libraries as complex systems.

Complexity Theories of Organizational Change

> Theoretical assumptions such as those of Theory Y imply some conditions which are unrealizable in practice (like the perfect vacuum implied by physical theory).[62]
>
> *Douglas McGregor*

Complexity theory has evolved in the scientific community as a response to unresolved issues, emerging outside of the purview of the laws of classical mechanics—living things being paramount to this view. Contemporary OD and leadership theorists argue that much of the management and leadership research in the early part of the twentieth century was taken from economic theory that found its origins and principles in the classical mechanics of the physical sciences.[63] However, Joseph Fourier's development of thermodynamics, Charles Darwin's observations of species environmental adaptation, Henri Poincaré's work on deterministic chaos, Albert Einstein's creation of the general theory of relativity, and Niels Bohr's development of quantum mechanics all challenged the emphasis on order, stability, and control inherent in classical mechanics.[64] Eric Jantsch, Humberto Maturana, and Francisco Varela and Stephen Jay Gould found several new ways to study and explain unpredictable phenomena in the biological sciences through autopoiesis and punctuated equilibrium.[65] Ilya Prigogine, Edward Lorenz, and Benoit Mandelbrot found concurrent anomalies in physical and mathematical systems, developing theories on dissipative structures, chaos, and fractals.[66] This research has been extended to economics, computer science, medicine, and cosmology with the creation of several university and private research centers for the study of complexity sciences around the world.[67]

More recently, complexity theory has become a mainstreamed research area in the social and behavioral sciences communities. A shift in how we view human experiences takes into account multiple interactions among individual agents as catalysts for system-wide phenomena. Complexity theory has evolved into a critique of reductionism and the subsequent lens of humans as ever more efficient automatons, exemplified in Taylor's scientific management. Therefore, complexity theorists view the social and structural aspects of human interactions and experiences as more natural phenomena rather than individuals as static agents who can be studied in the confines of a vacuum. Since librarians have entered a very turbulent, and perhaps chaotic, period in their profession, complexity theory can help to explain in more natural and human-focused ways how complex phenomena emerge and precipitate changes in academic libraries. Equally, since many of the current leadership and OD theories are disconnected or epistemologically at odds with one another, complexity theory enhances previous research in that it is able to incorporate many theories and models into an integrated whole, utilizing both qualitative and quantitative methods.

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The study of complexity theory includes three main branches of systems: dissipative structures, chaotic systems, and complex systems. Many books have been written on these subjects in both the scientific and social sciences research literature, and further reading is encouraged. The confines of this article do not allow for a comprehensive overview; however, a brief introduction to each is included for illustrative purposes.

The study of dissipative structures is originally attributed to Nobel Prize winner Ilya Prigogine and focuses primarily on systems moving from near-equilibrium to far-

from-equilibrium conditions in a natural, self-organizing manner in order for higher-system development to take place.[68] Chaotic systems are typically associated with the works of Lorenz and Mandelbrot, operate with simultaneous order and disorder, are typically bounded by system parameters, move iteratively toward strange attractors, and are sensitive to initial conditions over time.[69] Complex systems are typically attributed to the works of Craig Reynolds, Per Bak, and Brian Arthur. These systems contain simple rules and amplify the diversity of individual agents within a system in order for further organizational development, or "self-organized criticality" to take place.[70] Each of these systems can be viewed as a separate theory, yet all three theories typically have the potential to emerge within a complex system. Predictability in these systems is good, at best, during the very short term. Each system is highly sensitive to both internal and external energy or resource consumption. Each system also inherently uses self-organization to add and expend complexity from its structure(s). As a result, these theories can be integrated into a more general theory of leadership and OD—complexity theory.[71]

Although many systems theorists have been concerned with the structures of organizations, complexity theorists have further integrated the living systems view, moving toward the processes and interactions of individuals within groups. Ralph Stacey has contributed largely to the growth of complexity theory in organizational dynamics research studies. His earlier works identified organizations going through change as chaotic structures. Rapid shifts or demands from the external environment lead individuals within organizations toward hypercritical states, in which internal organizational stresses move a system away from equilibrium.[72] However, boundary conditions exist that are used by individuals to keep the organization from escalating into unbounded chaos. Likewise, in academic libraries, increased expectations by faculty and students for the changing roles of librarians and our libraries place us in similar conditional states.

Margaret Wheatley has also been extremely active in the OD community with her explanation of the benefits of complexity theory. Wheatley showed how the problem of wave-particle duality in quantum physics is representative of organizational thinking. In simplified terms, when a physicist performs research on light in wave form, the light will exhibit the characteristics of a wave. Conversely, when particle physics is performed, the light will appear in particle form. This duality manifests the role of the observer and how each of us may influence the advancement of an organization, depending on our perceptions as observers. Moreover, Wheatley contended that organizations are chaotic structures with boundary conditions that prevent us from escalating out of control. In part, and perhaps extremely important for librarians, the flow of information throughout a system keeps an organization moving iteratively toward strange attractors with an almost magnetic-like description.[73]

Gareth Morgan additionally focused on chaos and complexity theories as critical components of individual and organizational development. He argued that many organizational theories are actually images or metaphors designed to persuade individuals to see and understand the phenomena of organizational life in partial ways. Many issues with which we all are familiar in academic libraries—including power, politics, creativity, and stability—take on seemingly paradoxical or dualistic roles in understanding how

our organizations operate. The use of complexity theory, therefore, enables us to view simultaneous and emerging paradoxes of organizational conflict "between the status quo and alternative future states,"[74] and library leaders of the future must be skilled at recognizing these emerging paradoxes.

In addition to its tremendous potential for descriptive frameworks in qualitative case studies, complexity theory also includes quantitative methods for the analysis of leadership and OD. Ilya Prigogine and Gregoire Nicolis have provided several mathematical models for the study of complexity theory by quantitative researchers.[75] In the social sciences, David Byrne was one of the original theorists to argue for replications of these types of models to study human interaction.[76] Research literature in the field of social and industrial psychology, a close cousin of OD, is replete with post-positivist quantitative models for understanding individual and group dynamics. Most recently, Stephen Guastello presented several quantitative methods for analyzing complexity in OD and social psychology.[77]

Studies of Complexity Theory

> In this crisis phase the primary responsibility of management is to determine how to adapt and survive.[78]
>
> *Gary Yukl*

Complexity theory research is pervasive in the broader social and behavioral sciences literature. As one example, Richard Pascale, Mark Millemann, and Linda Gioja's case studies of complexity theory in the corporate sector have shown promising results. The authors attribute organizational successes to chaos theory in which species evolve in nature as a response to changes in their external environment, often to the benefit of their community. Many of our libraries are undergoing transformations that present visible and sometimes radical changes as a result of our user community's expectations. The ability to compete with enterprise search engines, Web 2.0 technologies, and social networks for research and discovery will be critical for our own survival and professional relevance in the future. Equally, genetic diversity in managerial promotions was another successful strategy used by complex organizations; and, as Charles Lowry and Paul Hanges discuss in the library science literature, this diversity can lead to better organizational health while avoiding the perpetuation of outdated modes of thinking about our organizations.[79]

Benjamin Lichtenstein's case studies of three major companies in the United States also showed the benefits of utilizing Prigogine's research on complexity theory when interpreting organizational transformation. In each of these cases, results showed that radical shifts in organizational functions led to nonlinearity in decision-making; that these shifts are the result of stress or tension that overloads a system's capacities to perform its normal functions, and that "system-wide change is usually preceded by an increase in intensity, tension, and a critical recognition of some sort."[80] During this three-stage process, individuals move toward a system process of self-organization, a transformative split in organizational thinking and structures known as bifurcation,

and then a period in which individuals contribute to organizational emergence with changes in mission, vision, and organizational structure that are radically different from the old organizational structures and philosophies. Karin Breu and Mary Brenwell, as well as Karen Newman, present very similar findings in the business research literature on companies operating as self-organizing dissipative structures in Central and Eastern Europe that are going through change.[81]

Robert MacIntosh and Donald MacLean drew upon the works of Ilya Prigogine, Eric Jantsch, Ralph Stacey, and Chris Argyris in their studies of private sector firms. These researchers focused on strategic change among organizations operating in turbulence as a result of competition with or closure from their external environment, which might be similar to the struggles academic librarians now face when competing with external purveyors of digital resources. Each organization under study reached bifurcation points when turbulence from outside market factors influenced the companies to respond adaptively.[82] MacIntosh and MacLean further developed their work on dissipative structures in organizational theory, coining the term "conditioned emergence."[83] In their study of a firm that had been performing poorly for a number of years, each new shift in management had reapplied the same rules the company had always known, thereby reflecting Argyris and Schön's concept of single-loop learning. MacIntosh and MacLean's research was designed, therefore, to help leaders identify and condition different phases of the transformative change process.[84]

Complexity theory has also been incorporated into educational curricula in MBA programs, in which students participated in experimental designs of leadership in small groups within far-from-equilibrium environments. Argyris's concept of double-loop learning emerged as both students and teachers became learners, and Stacey's intervention method for complex group processes was used to eliminate control functions and foster self-organization within these groups. Consequently, the authors of one study contended that, for the same reasons that the experimental teaching method moved learners into an uncertain and far-from-equilibrium environment,

> these experiences offer insights into our understanding of situations managers face when seeking to open up opportunities for new ways of working within established organizations.[85]

Results of a separate study showed similar effectiveness of self-organization in group dynamics.[86] Additionally, this complex systems movement in graduate management programs has also been addressed as a critical component of future library science curriculum development.[87]

Most recently, this author conducted a complexity-based case study analysis of an ARL library. Librarians at this institution identified many influences that contributed to the complex library environment, including technology, professional relevance, physical versus virtual places, organizational learning, and non-traditional leadership and organizational structures. The research included both micro- and macro- level case study analysis of these individuals operating in an academic library environment of continual change and created a model for OD and leadership of the library as a bounded chaotic system with periodic transformation.[88]

Applications and Limitations of Complexity Theory

Complexity theory helps to integrate seemingly disparate theories of OD and leadership. Equally, it bridges the divide between pure theory and organizational application of theory while considering multiple methods of research. As an example, researchers can choose to investigate specifically the micro level of the individual and his/her influences on an academic library. At the same time, this micro-level research can be integrated into a macro study of the organization through case study, survey, and interviewing methods of several individuals. This, in turn, can create a more cohesive picture or model of leadership and OD in academic libraries. Another approach can equally foster hypothesis generation at the micro level and subsequent testing for exploratory purposes at the macro level. Moreover, using methods similar to these, researchers can incorporate both qualitative and quantitative approaches to data analysis while allowing for seemingly disparate or conflicting findings to be explained or interpreted through both descriptive statistics and narrative.

Limitations do exist, however, for the use of complexity theory in understanding leadership and OD in academic libraries. Of paramount importance is the limitation of our ability to predict variables that influence our libraries over the long-term, as is the case with many positivistic models. Probability analysis and scenario building will, therefore, guide future studies of leadership and OD. Additionally, as Prigogine noted, large environmental fluctuations are needed for transformation to occur.[89] In organizational contexts, this implies that academic libraries going through small, transitional changes may not be particularly suited for complexity theory research, since the controlling feedback mechanisms that move the organization toward equilibrium are too strong for complex phenomena to

> **Probability analysis and scenario building will, therefore, guide future studies of leadership and OD.**

emerge and sustain development. Yet, academic librarians that are facing significant or turbulent changes are prime candidates for the study of complex phenomena that are attributed to rapid or dramatic shifts in environmental influences. Consequently, many of us might argue that the significance of recent professional shifts in thinking about our libraries exemplifies the need for studying complexity theory in our own changing environments.

Conclusion

Research on organizational development and leadership theories reflects an evolution in thought and action that is taking place. These theories are becoming more complex and have moved from only looking at one aspect of OD or leadership, such as behavior or trait theories, to investigating the interaction of multiple aspects of organizational dynamics and leadership as processes. These theories also show how normative and psychological behaviors can influence group thinking or contribute to organizational malaise. Moreover, many of the theories call into question how both leaders and followers can reflect on their practices and contribute more advanced ways of thinking

about organizations in the future by developing learning environments of continual change.[90]

Our current academic library system-states reflect the rapid, and sometimes turbulent, evolution that has taken place in recent years. Digital resources are typically preferred over print mediums and concurrently streamline and add further complexity to the research and knowledge creation process. Librarians integrate Web 2.0 technologies with information resources in ways that allow for global and multi-dimensional collaboration on scholarship but that place new demands on technological resources and knowledge. Physical spaces in libraries evolve toward changing learning and teaching needs that break from the historical traditions of academic libraries; and new organizational structures are integrated that adapt to complex and unpredictable decision-making that bring with them simultaneous psycho-social distresses and optimism among librarians. As Lowry noted, "Our best hope of success is the mobilization of all staff through continuous learning and engagement in organizational problem solving to meet the challenge of continuous change."[91] Consequently, complexity theory provides an evolutionary and adaptive framework for understanding these far-from-equilibrium conditions and how they influence leadership and OD in our libraries. This theory lends to a better understanding of phenomena that emerge through group interaction and helps provide a new view of the academic library as a complex system. Studies supporting leadership and OD theory show additionally how thinking about libraries as complex systems and learning organizations shifts our foci from traditional modes of operation and organization to respond to the rapidly changing external environment.

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