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AUTHOR	Cutright, Marc
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ABSTRACT

This paper proposes a model, based on chaos theory, that explores strategic planning in higher education. It notes that chaos theory was first developed in the physical sciences to explain how apparently random activity was, in fact, complexity patterned. The paper goes on to describe how chaos theory has subsequently been applied to the social sciences and social systems, with mixed results. An application of chaos theory for strategic planning in higher education is then introduced in the form of propositions based upon the theory, including: (1) the ideal outcome of planning is planning, not a plan; (2) planning begins with a distillation of the institution's key values and purposes; (3) the widest possible universe of information should be made available to all members of an institution; (4) dissent and conflict are creative, healthy, and real; (5) linearity does not work in strategic planning; (6) the institution should budget for failure; (7) the expense of time spent on planning is an investment; (8) the executive is empowered, not minimized, by chaos-savvy planning; (9) that which can be quantified should not be overvalued; and (10) the future is a creation, not a prediction. (Contains 48 references.) (MDM)

PLANNING IN HIGHER EDUCATION AND CHAOS THEORY: A MODEL, A METHOD

Marc Cutright
1996-97 Fulbright Scholar to
The University of Calgary
Faculty of Education
Graduate Division of Educational Research
and
Doctoral candidate
The University of Tennessee, Knoxville
Leadership Studies, College of Education

313 Arrow Drive
Signal Mountain, TN
USA 37377
Marc-Cutright@utc.edu

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Oxford University
Oxford, England
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INTRODUCTION

Among my intentions are a summary description of chaos theory as it has been articulated in physical and natural sciences in the past three decades; a notation of some recent and well-received applications of chaos theory to the description and explanation of social systems and organizations; and a description of a set of propositions, a model in essence, derived in large from chaos theory, a model I am using to explore strategic planning in higher education.

Most essential, however, is a general discussion of the controversy surrounding applications of chaos theory or related scientific metaphors to social systems, and the challenge this presents to "chaos-friendly" social scientists. There are several, diverse ways to approach this challenge, ways which lend support to such applications in the consideration of social systems. Among these strategies are research methods which tend to strengthen chaos-based, qualitative analyses of social systems.

CHAOS THEORY

Chaos, in the physical sciences, is not the randomness and lack of order that the term's common usage suggests. Chaos theory, instead, holds that many seemingly random activities and systems in fact evidence complex, replicated patterns. The behavior of these systems is nonlinear, that is, behavior feeds back upon itself and modifies the patterns. Outcomes are not proportional to the additive influence of change factors. Further, precise predictability of the system's behavior is restricted to a relatively short time frame.

Chaos theory's roots in science go back at least a century, to Henri Poincaré's proof that the gravitational and orbital behavior of bodies in the solar system could not be explained only with simple, Newtonian, linear physics (Hayles, 1990; Ruelle, 1991). But ongoing attention to chaos theory is more broadly considered to have begun with the work in more recent decades of meteorologist Edward Lorenz at the Massachusetts Institute of Technology*

Lorenz, in the '60s, was working on computer models of the weather in order to enhance predictability. He attempted to confirm the graphing of his models, recreating the inputs but rounding the calibration of the various factors from six to three decimal places in order to more lightly tax the relatively primitive computer he was using. Lorenz expected only minor variations from his initial runs. Instead, only after a few iterations, the patterns varied substantially, to the point of disintegrated correlation, from the original model. Prediction beyond a very limited time period became impossible, although general weather patterns and the boundaries of conditions were discernible (Gleick, 1987). This extreme sensitivity to initial conditions, or extreme sensitivity to influx in the case of ongoing systems, is characteristic of nonlinearity, and became known as the *butterfly effect*, after the notion that the flap of a butterfly's wings in Brazil might alter, eventually, the course of a tornado in Texas (Lorenz, 1993).

The explanation of the importance of small factors comes through the circumstance that chaotic systems are dependent upon *feedback*, the essential contributing condition of *nonlinearity*. As opposed to Newtonian concepts which more clearly differentiate between cause and effect, feedback is the notion that an effect becomes part of the cause in subsequent iterations of the pattern. Depending on the presence and nature of iterative

* The Soviets were making independent advances in chaos theory after World War II, but much of this research was unknown in the West until thaws in the Cold War made the exchange of scientific information more possible (Gleick, 1987)

patterns, small factors can--but not necessarily will--become multiplied over time. Senge (1990) explored this concept as related to organizations in *The Fifth Discipline*.

What, then, allows chaotic systems to develop any sense of pattern, to stay within boundaries? It is the existence of *attractors*. These are the elements in a system which have drawing or organizational power. A pendulum swinging in a simple back-and-forth pattern attracts toward gravity and its lowest point, and eventually stops; this is a point attractor. The presence of multiple attractors, while establishing boundaries upon a system, can result in unstable, complex patterns, with the attractors acting upon one another, and demonstrating greater sensitivity to influx. Multiple attractors can result in the creation of a *strange attractor*, or general pattern of system behavior. This interaction of attractors results in the quality of self organization, the ability to recreate order and pattern, at least temporarily, despite continuous compensation for internal and external shocks to the system, or turbulence (Parker & Stacey, 1994).

Chaotic systems demonstrate self-similarity at their various levels. In natural systems, self-similar structuring, called *fractals*, is evidenced in cloud formation, plant structure, blood circulatory systems, wherever chaotic organization itself is evidenced. A snowflake is a familiar fractal structure: at ever closer microscopic examination, the basic pattern is continuously repeated (Wheatley, 1992). Fractal structuring may be viewed as an artifact of the strange attractor.

To summarize, a chaotic system is one in which apparently random activity is in fact complexly patterned. Patterns, created by attractors, are disrupted and modified by the presence of smaller or greater levels of turbulence. Attractors allow systems to organize and stay within boundaries. Self-similarity of construction within chaotic systems is evidenced. The infinitely varied interactions of attractors and turbulence make specific pattern predictability difficult in the near term and impossible over the long term.

Investigators in fields as varied as astronomy, meteorology, geology, population ecology, and quantum mechanics, to name but a few, have verified chaotic patterns and constructed mathematical formulae to describe or mimic these systems (Newman & Wessinger, 1993). Chaos theory in social systems, many of which evidence anecdotal characteristics of chaos, has been more difficult to document, largely because of an inability to isolate or quantify seemingly infinite variables in open systems. But in disciplines such as economics or electoral political science, both of which yield enormous quantities of numbers and periodic measurements as compared to most social sciences, chaotic patterns have been confirmed and described in formulae (Gleick, 1987; Priesmeyer, 1992; Brown, 1995; Kiel & Elliott, 1996).

SOCIAL APPLICATIONS AND THE ISSUES SURROUNDING THEM

Noteworthy applications of chaos theory to social systems would certainly include Margaret Wheatley's *Leadership and the New Science* (1991), which struck such a chord within the American business community as to be named "book of the year" by the business magazine *Industry Week*. L. Douglas Kiel's *Managing Chaos and Complexity in Government* (1994) has been well received, and Kiel has subsequently made important contributions in both qualitative and quantitative considerations of chaos theory. Here in England, Ralph Stacey of the University of Hertfordshire has produced several important articles and a number of books linking chaos and related sciences to organizations, including *Complexity and Creativity in Organizations* (1996).

Without reference to these important authors, but rather in a general view of the field of related applications, the effort to link chaos to organizations has been irregular in depth and quality. The literature is frequently marked by the self-designation of chaos a "new paradigm" for viewing our world and its human constructs, associating it with the intellectual-breakthrough concept described by Thomas Kuhn as marking real scientific revolutions (1970). One limitation of such a self-designation it can be self-congratulatory, marking those with doubts about such applications as flat-earthers. The invocation of "paradigm" has also the limitation of obfuscating the researcher's claim of the depth of this science-social system connection. Does the author intend and propose that chaos is a model, or metaphor, and that chaos is therefore a lens and a language through which to gain some (limited) insights about organizations? Or does the author intend and propose that chaos is analogically applicable to social systems, that is, that social systems are part of a continuum of literal bases for chaos theory, a continuum in which would place organizations at the level of weather, fluid dynamics, orbital mechanics, and other areas of the physical world? (Harvard University science historian I. Bernard Cohen writes particularly clearly on the metaphor-analogy distinction [1994].)

The vulnerabilities of the proposed connections between chaos theory and social systems have been remarked upon by several authors. Faber and Koppelaar (1994) conclude that "[s]ocial science is not helped by the trendy application of sophisticated mathematical models." Johnson and Burton, writing in *The Journal of Management Inquiry*, say much with their title: "Chaos and Complexity Theory: Caveat Emptor" (1994). Hunter and Benson (1997, p. 89) call the "indiscriminate application of chaos theory to every kind of complex phenomenon...a misapplication and misinterpretation of the original ideas...."

Again without specific reference to any author cited above, and condensing print criticisms with those advanced in conversation and at conferences, the criticism of extension follows several patterns. Such critics hold that chaos theory is a mathematically articulated, natural-system specific set of principles, the application of which to social circumstances is both an unsupported, deductive overextension and a debasing of scientific language. These critics often cite scientists, including some founders of natural-system chaos, who have criticized, in general and specifically, social extensions. The critics also have at their critical disposal some very loose "applications" of chaos, applications which are sometimes little better than, "if we can't understand this situation's dynamics, then it must be chaos, so don't worry, it'll organize itself."

The extension of metaphor or analogy from the natural sciences to the social sciences, it should be noted, has a long and often successful history. Kellert (1995) points out that our concepts of historical "forces" and social "inertia," useful and long-standing concepts, derive from Newtonian mechanics. Much of modern economics is grounded as much in abstract, mathematical modeling as it is in descriptions drawn from real-life phenomena (Cohen, 1994).

Yet inappropriate metaphors and analogies are known as well. Contemporary disciples of Newton attempted to construct ideal models of government, and of the reliability of court testimony, based on the principles of gravity (Cohen, 1994). Frederick Taylor's "scientific management" of the early twentieth century has been largely debunked, yet based its claim to legitimacy in the scientific methodology of logical positivism and in physics isolated from subjective contexts (Taylor, 1911). Perhaps the most notorious of misapplications of science to social systems and their consideration is the example of Social Darwinism, the simultaneous misinterpretation and overextension of Darwin's speculations on evolution to the state of society. Social Darwinism came to be used in large as a rationalization for classism, racism, and imperialism, a rationalization that became more destructive as it hardened from metaphor to analogy (Cohen, 1994).

Caveat emptor, indeed. Notwithstanding, chaos theory appears to have utility and explanatory power in social systems. Principles of chaos theory, although lacking definition as such until the past few decades, can be tied to emerging nonlinear analyses and creativity throughout the 20th century, at least, and in a number of disciplines. N. Katherine Hayles, an American literary critic writing from a postmodernist viewpoint, has published extensively on the operation of chaos theory within literature, choosing to treat chaos "both as a subject of scientific inquiry and a crossroads where various paths within the culture converge" (Hayles, 1991, p. 4). Christopher Alexander wrote of architectural pattern language, and said, "for the fact is, that this seeming chaos which is in us is a rich, rolling, swelling, dying, lilting, singing, laughing, shouting, crying, sleeping *order*. If we will only let this order guide our acts of building, the buildings that we make, the towns we help to make, will be the forests and meadows of the human heart" (1979, cited in Wheatley, 1994, p. 109). Engineer Peter Schwartz and philosopher James Ogilvy wrote in 1979 of changing patterns of thought and belief in society, in fields as diverse as brain theory, chemistry, politics, religion, and linguistics. These changes included movements from the simple to the complex, from hierarchy toward heterarchy, from the mechanical to the holographic (fractal), from the determinate to the indeterminate, from the linear toward mutual causality, and from assembly toward morphogenesis. (Ogilivy and Schwartz were later cited quite generously by Lincoln and Guba in "Naturalistic Inquiry," 1985, as challenging to logical positivism and supportive of alternative qualitative research methods.) Early twentieth century management theorist Mary Parker Follett, whose work was largely ignored in favor of her contemporaries writing from "scientific" and mechanical perspectives, particularly Taylor and Fayol, has recently been discovered as a "prophet of management" (Graham, 1995). Themes obviously similar to chaos theory emerging from a reading of Follett include her emphases on the reciprocal influence of subject and object, the compounding of cause and effect, the development of natural patterns within organizations, and the nature of power not as an external element but an integral, shaping element.

Support for the extension of chaos theory to social systems is also common within the community of scientists and mathematicians who have defined its basic concepts. Ilya Prigogine, awarded a Nobel Prize in chemistry for his work on the thermodynamics of nonequilibrium systems, is largely credited for creating much interest in new applications of chaos and related complexity through the book he wrote with Isabelle Stengers and which they published in English in 1984, *Order Out of Chaos: Man's New Dialogue with Nature*. The book's original French title, *La Nouvelle Alliance*, reflected the authors' hope that the work would contribute to a "convergence of science and humanities" (p. xxix). Their hope was that a consideration of order beyond the boundaries of Newtonianism would help us address economic, demographic, and political challenges, among others (p. 19). French mathematical physicist David Ruelle, one of the conceivers of the chaos-theory term "strange attractor," opined that the efforts to establish quantitative evidence for the presence of chaos in economics and social sciences had, to that point, fallen short of conclusion. However, he also encouraged such inquiry, noting that 19th-century mathematician Henri Poincaré's early "considerations on predictability in meteorology were just scientific philosophy, and this domain is now quantitative science" (1991, p. 79). Considering the potential of a chaos application to an economic model, Ruelle believed that the application had "more than just metaphorical value"(1991, p. 83). Murray Gell-Mann, a Nobel laureate in physics, is similarly cautionary about the overextension of scientific theory to social systems, yet he is also a proud founder of the Santa Fe Institute, an interdisciplinary research center and think tank where, he has expressed the hope, chaos- and complexity-related schema will contribute to the consideration of "political, military, diplomatic, economic, social, ideological, demographic, and environmental issues" (Gell-Mann 1994, p. 346).

Those who consider chaos theory a well-articulated, complete, and proven system within the natural sciences perhaps overestimate the soundness of its grounding there, and underestimate the state of its development elsewhere under science's own ground rules. Much of what is put forward as proof of mathematical chaos in natural systems is in fact deduced from the construction of models which simulate natural systems but are not those systems themselves. Such is the case, for example, with Lorenz's original weather model. When chaos has been mapped in actual systems, these systems tend to be fairly simple and essentially closed, as with a dripping faucet. This is not dissimilar from the state of the mathematical art in social system considerations. Similarly, models of social systems have been put forth which appear to mimic the real world (e.g. Cartwright, 1991; Overman, 1996), and progress has been made in the literal mapping of chaos in social systems, particularly those which produce copious amounts of numerical data about a limited number of dimensions, such as in economics and electoral politics. Some particular, excellent examples of this progress have been put forth in 1996's collection of research efforts, *Chaos Theory in the Social Sciences* (Kiel & Elliott) and in 1995's *Chaos and Catastrophe Theories* (Brown).

To summarize, the states of "proof" of literal chaos in natural and social systems are not so far apart as one might think. Chaos theory was emergent, under different names, as an analytical framework in social systems before the latter-day description of these principles. Given these circumstances, chaos theory might be considered somewhat more broadly, not just as a set of mathematical principles of narrow application, but as a *language* which is capable of describing and shaping our understanding of phenomena across disciplines and specific circumstances.

AN APPLICATION

An application of chaos theory that I am investigating is a consideration of its utility in shaping a model for strategic planning in higher education. Some detailing of this model, a series of propositions, will permit a specific context for a discussion of confirmation strategies.

Strategic planning in American higher education received an early definition and a strong boost from George Keller with the publication in 1983 of *Academic Strategy: The Management Revolution in American Higher Education*. Keller defined strategic planning as an active positioning of an institution, focused on the external environment. It is a process that is market-competitive, decision-oriented, blending of quantitative and qualitative factors, and concentrating above all on the fate of the institution (pp. 143-153). The author later (1993) estimated that while no more than a dozen of 3400 colleges and universities in the U.S. were engaged in strategic planning at the time of the book's publication, a decade later perhaps a quarter of those institutions were engaged in strategic thinking and action.

Yet Keller also acknowledged that a considerable number of these initial efforts had failed (1993). Jones (1990) was more pointed. His estimate was that for every three institutions which had initiated a planning process in the 1980s, two had fallen away from it and had gone back to "business as usual" (p. 52). A study published in 1994 by the American Council of Education (Schuster et al.), inspired by Keller's work and seeking to examine the state of strategic planning as evidenced on eight campuses, found mixed results and some outright failure.

Strategic planning enjoys a longer and more storied history in the corporate setting than in higher education, and so of interest is the publication in 1994 of *The Rise and Fall of Strategic Planning* by Henry Mintzberg of Canada's McGill University. Reviewing the common failure of corporate planning efforts, Mintzberg noted that the mid-90s were an appropriate time for the book's publication; had he published earlier, he believed, his specific points might well have been lost in the vast backlash against corporate strategic planning in the 1980s.

And so we have a general state of strategic planning, particularly within higher education, which begs examination and a continued search for improvements of process. Chaos theory applied to this circumstance, I believe, suggests not only limitations for strategic planning, but guidelines for its execution and promise for its success. I have begun expanding on these implications in other forums (Cutright, 1996, 1996-97), but will only summarize them here and tie them only lightly to specific elements of chaos theory:

1. <u>The ideal outcome of planning is planning, not a plan</u>. Dwight Eisenhower, as commander of allied forces in World War II, was more direct: "Plans are nothing. Planning is everything" (Keller, 1983, p. 99). Planning is not the production of a fat blueprint. Rather, it is a strategic direction and central strategy which, as chaos theory

would suggest, is designed flexibly enough to be sensitive and response to turbulence in the environment.

Large, detailed plans, issued on time horizons of five, ten, or more years, are common in higher education. Further, they are sequentially structured, with each step dependent upon the completion and on a specific time line, of precedent steps. This is, suggests one author, somewhat like playing a game of pool by specifying, before the commencement of play, each and every shot through the sinking of the eight ball (Priesmeyer, 1992).

Chaos theory tells us that because of the impossibility of long-term predictability, plans should be general, flexible, and relatively detail-free. Detailed operational plans subordinate to the strategic plan can be brought to and from the stage as warranted.

2. Planning begins with a distillation of the institution's key values and purposes. This idea relates to the identification or creation of attractors, in this case ideas or philosophies which will give central organization and priorities to the strategic plan. Typically, within natural systems, chaos is characterized by only a few, strong attractors. The flocking of birds, for example, is accomplished by compliance with only three rules: keep a minimum distance from other birds, move at the same speed, and head toward the densest concentration in the vicinity (Waldrop, 1992). That may explain why institutional mission statements are rarely of much help in strategic planning. Satisfying everyone and offending no one, they tend toward being kitchen sinks of collected ideas and goals, good and bad, littered with platitudes, and with little sense of priorities. Mintzberg declined similarly the "empty platitudes" at the heart of most planning processes (1994, p. 297).

3. The widest possible universe of information should be made available to all members of the institution. This universe of information includes ongoing, rich, and current feedback, including feedback on the planning process itself. Keller (1983) originally advocated the existence of campus Joint Big Decision Committees, operating somewhat secretly, which would make the "tough" decisions necessary for genuine strategic planning. He later modified this view (1988), concerned that secrecy engendered distrust and denied critical feedback to planners.

Chaos theory suggests that virtually unimpeded access to information is necessary for the early identification of "butterfly wings.". An avalanche of information can be as detrimental to the processing of that information as a deficit of its supply. This is not a rationale for the restriction of information flows, as is oft times the excuse, but a rationale for its organization.

4. Dissent and conflict are creative, healthy, and real. The absence of conflict is reductionist, illusory, and suspect. Chaos theory recognizes and respects the power of turbulence. It is the essence of creativity in chaotic systems, and it is from this "edge of chaos" that new patterns and ways of doing business emerge (Stacey, 1996).

Early 20th century American management theorist Mary Parker Follett reached very similar conclusions before chaos theory. Follett distinguished our various ways of dealing with conflict as domination, compromise, and integration. Chaos theory would suggest that domination and compromise delay or ignore the system turbulence. Integration, solutions in which the desires of all parties are considered and blended, is the solution most consistent with chaos theory. Certainly, not all conflicts will lend themselves to integration, but without explicit recognition and open discussion of conflicts, such integration is impossible (Graham, 1995).

5. Linearity doesn't work in strategic planning. It doesn't work in dictation--planning and plans imposed from above--or in collation--planning and plans created solely by the collection of unit information. The reader may agree on the obvious limitations of top-down planning: strange attractors are not identified, feedback is denied, faint recognition of the environment is inevitable, and the implementation of plans is made virtually impossible by a lack of fractal structuring. The limitations of bottom-up planning may be less obvious.

Collation is the collection of individual "plans" by departments, then at the college or school level, and so on to the organizational pinnacle. This may seem related to democracy, but in fact such a process lacks the connectivity between elements of a system that is key to and reflective of fractal structuring.

6. The institution should budget--fiscally and psychically--for failure. Pilots are alternate futures. Not all can be realized or succeed. Universities are historically averse to change, even those changes which are ultimately and broadly adopted in higher education (Siegfried et al., 1995). Yet strategic planning by its nature attempts to make some tentative decisions about and preparations for the future.

Schmidtlein (1989-90) has documented that universities very rarely make any budgetary allowances for piloting or experimentation. They don't allow for opportunities or ideas that emerge outside the budgetary frame. But chaos theory suggests that the predictive range of planning is shorter than the start-up and testing of complex projects. Therefore, allowance should be made, both budgetarily and for the energies of personnel, for pilot projects, with the knowledge that, despite our best predictive efforts, not all will succeed. Piloting, at best, positions us to pursue expeditiously a variety of emerging, alternate futures.

7. The considerable expense of time on the front end of planning is an investment. It is recouped, with interest, in the future. There is little question that top-down, stripped-down, feedback-free planning is faster. This is a false economy. Fast plans may be convenient, even poetic, but time and resources will be spent subsequently and inefficiently as institutional leaders attempt to impose plans alien to the system's actual dynamics. Alternately, a plan developed from these dynamics, and not against them, will be more fully implemented, more reflected at fractal dimensions of the organization, more in concert with the organization's attractors, and more successful.

8. The executive is not demoted or minimized by chaos-savvy planning. The executive is the most critical shaper and champion of the process. Ultimately, the executive is empowered by the process. Far from holding only figurehead status, the executive, the university president, is a critical element in the process of planning. While the president may yield some up-front, unilateral authority to the process, he or she ultimately gains power from the planning process. Once priorities are established through broad participation and debate, the executive in enhanced in the ability to make decisions, hire and fire personnel, allocate resources, commence and terminate programs. The president leverages support for such actions by tying them to the institution's goals and visions.

It may be said, then, that a president acts as an attractor in the planning process, giving the process legitimacy, broad goals and parameters. A president who exercises this power too strongly, however, risks becoming a single-point attractor; like a pendulum being drawn toward a point of rest, the planning process in such circumstances becomes inert as participants sense their efforts to be futile and their risks possibly punished (Platje & Seidel, 1993).

9. That which can be quantified is not to be overvalued, and that which cannot be quantified is not to be discounted. The dominant "fact" of the planning future going into the 1980s in the U.S. was a declining pool of traditional-age students, which would result in the closing of at least 10%, and perhaps as many as 25% of America's colleges and universities within a decade or so (Keller, 1983). What actually occurred was an increase in college enrollments through the '80s. Linear planners, who had depended on the convergence of data trend lines at some point in the future, did not take into account those factors they could not quantify, including institutional creativity, the upshot in enrollments by women, and the development of a new market of older students.

Chaos theory suggests that, as with weather prediction, increasing the bulk of our numerical data quickly hits a point of diminishing return in our efforts to predict the future. Nonquantifiable trends and emerging ideas in society are butterfly wings, which may affect our systems disproportionately to their current strength or ability to be meaningfully quantified.

10. The future is a creation, not a prediction, and time is an ally. This power of agency is the distinguishing context of human chaotic systems. It would be an error to conclude from chaos-suggested unpredictability that planning is futile. The opposite is true, if we look at planning as the creation of the future, rather than the mere realization of a future predicted by the long-term projection of data. Participants in nonlinear planning come to realize that the future is largely their invention; the external and internal environments are strong creative elements of the future, but so are dreams, values, and ambitions. The flutter of a small wing can move not only the breeze but organizations, particularly if applied with some consistency and in partnership.

SOME APPROACHES TO QUALITATIVE CONFIRMATION OF CHAOS

The establishment of quantitative evidence of chaos theory within social science faces mathematical problems. The inability to isolate and quantify all influential factors typical to social systems is high among these; social systems are, virtually by definition, open to influx and turbulence, factors which will mutate mathematical patterning. Efforts to break down social systems into small, mathematically analyzable pieces is also somewhat contrary in spirit, and therefore from one perspective counterproductive, to the holistic understanding of social systems that chaos theory applications attempt (Gregerson & Sailer, 1993).

Qualitative evidencing of chaos theory, therefore, seems a promising route of inquiry. But of course, qualitative research continues to confront such challenges as confirmation bias and selective reporting supportive of a theoretical framework. When one adds to this a basing from an unproved model, such as one derived from a consideration of chaos, the potential elusiveness of the situation seems much like Katherine Hayles (1991) description of chaos itself: the pattern of a pendulum swinging from the end of another pendulum.

I would suggest that an accepted approach in the validation of findings in qualitative research, triangulation, is appropriate for support of the research model itself. Triangulation, a term taken originally from land surveying, refers to the support of research findings by the consideration of several types of data or consideration of the data through more than one perspective (Patton, 1990). Triangulation may occur, for example, through a mix of qualitative research methods (interviews, document content analysis, etc.), or through a mix of qualitative and quantitative research methods (Marshall & Rossman, 1995; Yin, 1994). Although no method is conclusive in itself, nor is their combination, triangulation tends to strengthen arguments for the validity of qualitative research by a narrowing of the possibility of gross error.

A social-system model following from natural science, such as I have proposed for strategic planning, derives first from a consideration of the original natural-science application and a consideration of possible homologies between the physical and social systems. A first and basic form of triangulation of the resulting model is heuristic. That is, does it make sense within the experience of the reader? Does the researcher have a reasonable argument for the model? Does the model appear to have explanatory potential? Sensemaking, however, is only a preliminary form of triangulation, and a low form at that; many theories and models sensible at their proposal have later proven unworthy.

A somewhat higher form of triangulation for a model might be its compatibility with broadly accepted views and literature. I believe the model I have proposed to be highly compatible with advice and cautions about strategic planning as advanced by Mintzberg (1994), Keller (1983), and others. Of course, a useful model must necessarily advance in some way our view of the system to which it is applied, or it is redundant. One hope for my model, for example, is that it may offer perspectives for the appreciation of simultaneous operations of hierarchical structures and loose coupling within organizations (Weick, 1976), concepts which are usually represented in oppositional and dichotomous terms in higher education literature and operations (Orton & Weick, 1990).

The traditional case study method is another form of triangulation for a proposed model. Multiple case studies conforming in large with the model can provide "analytical generalization" (Yin, 1994, p. 31), and support the model through replication of findings.

Triangulation might come from the explicit or summary examination of the model directly by interviewees and system participants. This method has the potential drawback of inducing bias toward the model, the possibility that presentation of the model might be indistinguishable from advocacy of it and thereby "put things in someone's mind" (Patton, 1990, p. 278). But in the particular context of my interest (institutions of higher education) and in many such situations of model development, the researcher will be involved with "elite" interviewees (Marshall & Rossman, 1995). These are individuals who are likely to expect "active interplay" with the interviewer, who are at home in the "realm of ideas, policies, and generalizations," and who can reward "accurate conceptualization of the problem" with contributions of "insight and meaning" (p. 83-84). It follows logically from participant access to the model that participant access to the preliminary findings is appropriate. This is a complementary and additional form of triangulation of the model, as well as of the research report and conclusions.

Not every field testing of a model will involve elite interviewees. If this is not the case, or if doubt exists, an alternate method of testing might be a Delphi procedure, in which the model is submitted to examination and comment by experts in the general field or fields, experts external to any cases being researched. Such a procedure might consist of several rounds of examination and shared comment as the model is improved.

Qualitative methods of inquiry were the first front in the establishment of chaos theory in physical systems. Qualitative methods will continue to be an important front in investigations of chaos theory in social systems, even if the intriguing advances being made through quantitative research in these areas continue at their encouraging pace. Proven methods of testing and confirmation are available to us in these qualitative efforts, methods of great utility and persuasiveness in other contexts.

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Name: Marc Cutright

Signature: Marc Cutright

Organization: University of Tennessee, Knoxville

Position: Doctoral student

Address: 313 Arrow Dr., Signal Mtn, TN 37377

Tel. No.: 423/886-7728 (h) 423/755-4363 (o)

Zip Code: 37377

E-mail: Marc-Cutright@utc.edu

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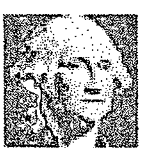

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