Market Orientation Within University Schools Of Business: Can A Dynamical Systems Viewpoint Applied To A Non-Temporal Data Set Yield Valuable Insights For University Managers?

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ABSTRACT

This study investigates the use of using complexity theory – the study of nonlinear dynamical systems of which chaos and catastrophe theory are subsets – in the analysis of a non temporal data set to derive valuable insights into the functioning of university schools of business. The approach is unusual in that studies of nonlinearity in complex dynamical systems typically involve longitudinal data. Challenges associated with such studies usually involve establishing nonlinearity, obtaining a data set with a sufficient number of entries, and robust mathematical and computational requirements for effective analysis. The format of the paper is as follows: 1) a general description of complex systems is presented which identifies a number of generally accepted characteristics of complex systems, 2) a description of the data set and the research technique utilized, 3) a presentation of the data set as an "attractor" landscape as typically defined in complex systems analysis, 4) potential insights that may be derived from the analysis; and 5) conclusions and recommendations for further study. The value of the study is to demonstrate that within the framework of complexity theory, non longitudinal data may be used to derive valuable managerial insights into the functioning of organizations such as university schools of business.

Keywords: Complexity analysis, chaos theory, catastrophe theory, dynamical systems, consumer behavior, market orientation and group dynamics.

INTRODUCTION

This study investigates the use of complexity theory – the study of nonlinear dynamical systems of which chaos and catastrophe theory are subsets – in the analysis of a non temporal data set to derive valuable insights into the functioning of university schools of business. The approach is unusual in that studies of nonlinearity in complex dynamical systems typically involve longitudinal data. Challenges associated with such studies usually involve establishing nonlinearity, obtaining a data set with a sufficient number of entries, and robust mathematical and computational requirements for effective analysis. See Brock(1991), de Graaff (2001), Gilmore (2001), Goldenberg (2001), and Douglas (1993). The appropriateness of using complexity theory to analyze organizations as complex dynamical systems is well established in the literature. See Guastello (1995), Holbrook (2003), McBride (2005), and Smith (2002). This study assumes that extant research has sufficiently established the appropriateness of viewing the organization as a complex dynamical system and techniques of analysis associated with complexity theory may be appropriately applied to the study of university schools of business.

COMPLEX DYNAMICAL SYSTEMS

The distinguishing characteristic of complex dynamical systems is nonlinearity. Complex systems are composed of related entities, people, variables, cells, plants, animals, accounting, marketing, management, finance, etc. that share interdependent relationships that are nonlinear in nature. When these complex systems further possess the characteristic of interactivity with the environment, draw resources from the environment and accept feedback from the environment, they are said to be "open systems" and become complex dynamical systems. A number of generally accepted characteristics of complex dynamical systems include: sensitivity to initial conditions, transforming (positive) feedback, boundary conditions, coupling, butterfly effects, the existence of various "attractors", the ability to self-organize, the edge of chaos far from equilibrium, and the potential for chaos or catastrophe. The study of complex dynamical systems is frequently referred to as chaos theory or catastrophe theory. Chaos is an "umbrellas term for various approaches to an exploration of nonlinear interdependent systems". (Goerner 1995, 4.) Chaos has been variously defined as the geometry of behavior, (Goerner 1995), the formless void from which order arose, controlled disorder, and a state of matter in which order is not present but is latent and can emerge in the twinkling of an eye. (Freeman 1995). The emergence of structure is an important characteristic of complex dynamical systems. Understanding nonlinear interdependence is key to understanding how, why, and when, systems structure themselves – self-organization. (Goerner 1995, 4). Understanding nonlinear interdependence has profound implications for understanding the way marketing systems and organizations function. The image of the organization as an intricately interwoven, self-ordering entity, characterized by nonlinear dynamics is well supported in the literature. (Goerner 1995, 14). The authors believe chaos theory provides a holistic platform for integrating the many diverse approaches to understanding organizational functions. Traditional analytical approaches focused upon marketing, management, finance, production, etc. do not adequately explain the major focus of any of the others. The dynamical systems approach provides a theoretical modeling strategy, an experimental analysis and design strategy, in a holistic process oriented approach focusing upon multiple interactive variables of a system. The organization viewed through the lens of complexity is both radical and familiar.

THE BUILDING BLOCKS OF COMPLEXITY

Sensitivity to Initial Conditions

Sensitivity to initial conditions is one of the hallmarks of complex dynamical systems. Sensitivity to initial conditions flows directly from nonlinear relationships among system components. Nonlinearity means there is not a one to one relationship between variable inputs and variable output effects. Very small, even minute, changes in initial conditions can cause systems to diverge dramatically over time as the impact compounds at an exponential rate (butterfly effects). Thus, while the system is mathematically deterministically defined, system output is not predictable in the long run and no two systems will ever evolve identically. Examples of system outputs are human beings, fingerprints, snowflakes, and DNA. All are the "same" but none are identical.

Transforming Feedback

Two kinds of feedback exist in dynamical systems; positive feedback and negative feedback. Feedback is bi-directional, both forward and backward. Negative feedback is used as a control parameter to keep systems functioning within a desired operating range. Examples of negative feedback control include air conditioning and heating systems controlled by a thermostat, automobile speed controlled by a brake and an accelerator, business organizations controlled by accounting systems, budgets, and rates of return. When system operation approaches some set limit negative feedback is used to bring system operation back within some desired operating range. Negative feedback maintains system operation in its current mode and prevents the system from transforming itself into a different mode. Positive feedback is transforming feedback. Positive feedback reinforces itself exponentially and pushes the system further and further from a current stable mode of operation eventually transforming the system into a different state of operation sometimes referred as a phase state, or into chaos.

Self-Organization

Is the ability of a system to create and/or maintain structure. Self organization is a function of feedback. Positive feedback (transforming feedback) is the mechanism by which a system develops and evolves structure. Negative feedback (autopoiesis) is the mechanism by which a system resists change and maintains structure. The two somewhat opposing forces together represent self-organization.

Coupling

In a complex dynamical system, coupling is a common phenomenon. Coupling refers to the method by which previously unrelated things become bound (coupled) together into a larger whole. The coupling mechanism reflects the nature of the relationship and the interdependence between system components. In complex dynamical the interdependency is almost always nonlinear. Boundaries are created between system components by the coupling action. Systems may be characterized by the nature of the boundaries created by the coupling action. Some boundaries are tightly coupled, some are loosely coupled, some are permeable with respect to information flow, some are impermeable with respect to information flow, some boundaries are well defined and others almost indistinguishable.

Attractors

Complex dynamical systems operate under the influence of certain "attractors" which determine system behavior. In the vernacular of complex dynamical systems, attractors may be either point attractors, periodic attractors, or strange attractors. An attractor is one of the governing forces of a complex dynamical system. A system will typically operate under the influence of multiple attractors at any given point in time. A system under the influence of a point attractor corresponds to a system at rest or a system progressing to equilibrium. A system under the influence of periodic attractors exhibits cyclical activity. Systems operating under the influence of periodic attractors and far from equilibrium may achieve stability but not equilibrium. Strange attractors define the boundaries within which system behavior can occur and are analogous to the culture and climate of an organization. Systems under the influence of strange attractors may absorb enough energy to push their operations to the edge of chaos far from equilibrium. When pushed past the edge of chaos, systems enter a state of disorder (chaos) in which bifurcations (changes in attractors) occur and the system begins operation in a new "phase state". Systems normally undergo a number of bifurcations before achieving a stable phase state of operation at the edge of chaos far from equilibrium. It is at the edge of chaos that systems seem to be most adaptive and exhibit the ability to self-organize most effectively. The most effective systems operate continuously at the edge of chaos without straying over the boundary into chaos or catastrophe. It is also at the edge of Chaos that systems are most susceptible to shocks (butterfly effects) from the environment that may push them into chaos or catastrophe.

THE ORGANIZATION AS A COMPLEX DYNAMICAL SYSTEM:

As noted above, the organization viewed through the lens of complexity is both radical and familiar. The components of the organization are well known and familiar. In a traditional reductionist view, the organization is easily broken down into a set of component parts, i.e., marketing, finance, human resources, accounting, production, etc. The whole is somehow equal to the sum of its parts much as an automobile is equal to an engine, a transmission, an ignition system, a steering mechanism, etc.. Analysis of the individual parts yields insight into the behavior of the system.

Chaos theory allows one to focus upon the organization as a complex dynamical system where the whole is much more than the sum of the individual parts. Chaos theory is the geometry of behavior. (Goerner, 1995, 7). Complexity analysis raises questions such as what are the "attractors" of the organization, how are the organizational variables "coupled" together, what is the nature of "boundary conditions", how does the organization "self-organize", how does the organization maintain "stability" at the "edge of chaos" far from equilibrium, how does one identify "butterfly" effects that have the potential to send the organization over the edge into chaos or catastrophe? These questions certainly represent a nontraditional way of viewing the organization. The current

study is an attempt to apply Chaos theory concepts to non-temporal data. Complexity concepts used in the current analysis include attractors, coupling, and boundary conditions.

As noted above, attractors come in different forms and organizational behavior respond to multiple attractors at any given point in time. For an organization, the "values" of the organization serve as attractors. The values may be point values such as a certain level of consumer satisfaction, periodic values such as quarterly, semi-annual, or annual rates of return, or strange attractors which function as umbrella values and determine acceptable limits or ranges within which the system may function and may be thought of as social or cultural values. Values may be hierarchical. System effectiveness is affected by how well hierarchical values scale across the system, i.e.; customer values, organizational values, department values, individual values. System effectiveness is also impacted by the characteristics of coupling and boundary conditions among system variables.

Put in another way, a system where values scale well across the system, variables are coupled tightly, and boundaries are permeable would likely perform very differently from a system where values do not scale well across the system, coupling among variables is loose, and boundaries are not permeable. Analogous for example, to a car with tires properly balanced, steering properly adjusted, and transmission functioning properly to a car with tires out of balance, steering with slack, and transmission that doesn't shift properly.

In the current study, a hierarchical "landscape" of system values "at a point in time" is developed and analyzed from the points of view of system scaling, coupling, and internal and external boundary conditions. The data set includes information from academic vice-presidents, deans, marketing department chairs, and corporate business managers. The hypothesis is that complexity analysis can yield valuable insights into system functioning from a non- longitudinal data set.

THE DATA SET

A cover letter, survey instrument, and business reply envelope were mailed separately to the academic vice-presidents, business school deans, and to the marketing chairs of schools of business holding membership in AACSB-International. After a follow-up letter, 102 useable responses were received from the academic vice-presidents, 141 responses from the deans and 94 responses from the marketing department chairs. As key informants, (Campbell 1995; Phillips 1981), the vice-presidents, deans, and department chairs were asked to complete the survey and return it in the business reply envelope.

The questions to measure the three subscales (competitor orientation, customer orientation, and organizational coordination) in the Narver and Slater original scale were modified somewhat to conform to the vocabulary and the types of stakeholders prevalent in academic institutions. For example, two of Narver and Slater's questions were:

1. Our objectives are driven by satisfaction of our customers.
2. We measure satisfaction of our customers systematically and frequently.

The questions were amended for the current research and were worded as follows:

1. Our objectives are driven by satisfaction of our students/employers of students
2. We measure satisfaction of our students/employers of students systematically and frequently.

Churchill (1979) suggests that the appropriateness of scales borrowed from other studies needs to be addressed before survey research is accomplished. Therefore, all our scale items were pre-tested before mailed. We consulted with several academic vice-presidents, deans, and marketing department chairs. These consultations resulted in a research instrument and cover letter that more clearly defined the purposes of the research and the rewording of several questionnaire items.

15 questions were used in the collection of the data. Each of the questions were to be answered using a seven (7) point scale that was anchored with "not at all" (1) and "to an extreme extent" (7) so that the higher

numbers represented a higher (or greater) perceived level of market orientation. The survey questions are shown in the appendix to the paper.

The scales were subjected to reliability analysis, exploratory factor analysis and confirmatory factor analysis prior to use (Wheaton, Muthen, Alwin, & Summers 1997; Bentler & Bonett 1980; Marsh & Hocevar 1985; Bentler 1990; Browne & Mels 1992; and Browne & Cudeck 1993). Results of these analyses indicated satisfactory reliabilities (ranges from .73 to .91), satisfactory item-to-total correlations (ranges from 0.3 to 0.8), exploratory factor loadings ranging from 0.33 to 0.89, and confirmatory factor loading ranging from 0.36 to 0.82. Additionally, the confirmatory factor analysis demonstrated generally acceptable fit. These test results included comparative fit index measures ranging from .784 to 1.000, a Tucker-Lewis index ranging from .702 to 1.000, and the CMIN/DF ranging from 2.05 to 2.56. The RMSEA low values at the 90% confidence interval fell below 0.10 for all scales.

Although the literature indicates (Berdie 1989) that the presence of nonresponse bias in mail surveys does not necessarily alter the survey findings, we nonetheless proceeded to test for nonresponse bias. We used Larson and Catton's (1959) proxy methodology wherein potential nonresponse bias between early and late respondents is examined. These tests indicated no statistically significant difference between the early and late responders.

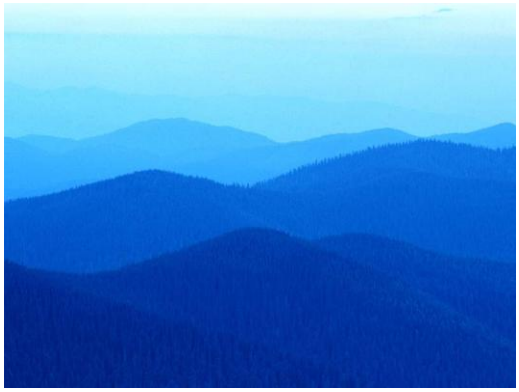
Then, following the methodology of Narver and Slater, we combined the three subscales to form an overall, or composite, measure of market orientation. We then conducted separate t-tests for each of the four dimensions of market orientation to determine if a statistically significant difference existed between the various market orientation mean scores of the academic vice-presidents, deans, marketing department chairs, and the corporate business managers.

THE DATA THROUGH THE LENS OF COMPLEXITY ANALYSIS

To this point in the study we have used a traditional approach to create an organizational value construct which we refer to as market orientation. The market orientation construct was composed of four components of market orientation and factor analysis demonstrated an acceptable fit with loadings for each component of market orientation and each group of university administrators, with statistical tests of significance for difference establishing the hierarchical validity of the market orientation construct for the study group. The resulting market orientation construct can be viewed as a value (attractor) landscape for academic vice-presidents, business school deans, and marketing chairs in AACSB accredited schools of business and business managers. Of course, the study would need to be broadened to include additional administrative levels both vertical and horizontal within the organization as well as additional values (attractors) to achieve a holistic viewpoint.

The values (attractors) that drive organizational behavior may be thought of as a values "landscape" such as Figure 1.

Figure 1



In this particular study, the values landscape is analogous to a composite model of the value components of the market orientation construct for the three levels of university administrators and the business managers studied. A complete landscape for the market orientation factor would include all components that contribute to the market orientation construct. A complete landscape for all the values of all the individuals in an organization would look pretty much the same as figure 1 but with infinite levels of self-similarity.

Therefore, figure 1 could be used as a model to study any part or all of an organization depending upon the scope of the data. A reflective study of figure 1 yields a number of insights. A traveler through such a landscape is presented with a number of alternative paths to choose. The landscape offers numerous peaks, valleys, and saddles to be traversed. Ultimately there is only one destination that is the highest point in the landscape. If each of the peaks represents a component of market orientation and each of the valleys represents a component of some other value that is seen as the opposite of market orientation (cost minimization for example), it is easy to see that the pursuit of higher and higher values of market orientation sometimes must be trumped by competing values. It is possible for an organization to become "trapped" on a suboptimal peak with no opportunity to climb higher without first sacrificing the market orientation value. An organization that accepts this situation as a stable operating condition is sub-optimizing. Complexity analysis reveals a possible way out of the sub-optimizing trap. Through a transition of "phase space" (a bifurcation in chaos terminology) the organization may be able to "leap" from peak to peak in the landscape and thus achieve higher values of "market orientation". The phase space transition effectively reorders the landscape in a way that provides the organization an opportunity to move forward without first retreating. This is an example of creative self-organization at the edge of chaos.

In hierarchical organizations value landscapes are scaled across the organization. The degree of scaling has implications for and is a function of the boundary conditions existing within the organizations and with its environment. Coupling may be tight at one extreme or loose at the other extreme. Boundaries may be permeable and allow relatively free flow of cross boundary information and resources or they may be impermeable and offer strong barriers to the cross boundary flow of information and resources. Boundaries may be highly defined or subtle and so indistinct as to be hardly recognizable. Self-Organizing systems both create and maintain structure. The ability to self-organize is a direct function of the permeability and coupling characteristics of the boundaries both within and external to the organization. Permeable boundaries are essential to the free flow of both positive (structure creating) and negative (structure maintaining) feedback. .Organizational boundaries may be designed to permit negative (structure maintaining) feedback while not allowing positive (structure creating) feedback. Organizations exhibiting closely coupled boundary conditions are more likely to act and react as a coordinated unit than organizations possessing loosely coupled boundaries. Thus, it would seem that organizations possessing tightly coupled, permeable boundaries would be the most efficient at self organization (most adaptable).

The values landscape fit between various levels of an organization has implications for the way the organization is structured. Organizational structures characterized by strong contrast among landscape values at different levels within the organization must have tightly coupled boundaries that are permeable to negative feedback and highly impermeable to positive feedback. This is a description of tall, vertical organizations. On the other hand where the landscape values scale well throughout the organization, organizational structure may be flat, loosely coupled, with more subtle highly permeable boundaries that permit both positive and negative feedback. Current management theories tend to favor the flat organizational structure as more effective in a dynamic environment. As suggested above, a tightly coupled flat organizational structure would be more efficient at responding to positive feedback than a loosely coupled structure.

It is the thesis of this paper that non-temporal data of the type produced in this study can be used to reveal differences in values landscapes in the organization. This information can be used to facilitate design of an organization with the proper emphasis upon negative and positive feedback to enable the organization to thrive effectively as a self-organizing entity. The data reveal that there is a hierarchical component to the market value landscape of university vice-presidents, deans, and market chairs in AACSB accredited schools of business. The hierarchical value discrepancies though not large are for the most part statistically significant. See Table 1.

Table 1
Means and t-test Results for Marketing Department Chairs, Business School Deans and Academic Vice Presidents versus Specialty Business Managers
Market Orientation Measurements (7 point scale)
Customer Group: Students

Market Orientation Construct:	Business Managers n=75	Marketing Chairs n=94	Business Deans n=141	Academic VPs n=102
	M	*M*	*M*	*M*
Customer Orientation	5.05	4.75*	4.55*	4.77*
Competitor Orientation	4.71	3.46*	3.71*	4.17*
Interfunctional Coordination	4.53	3.98*	4.13*	4.44^
Overall Market Orientation	4.77	4.06*	4.13*	4.46*

*significant at .01 compared to Business Managers ^ not statistically significant compared to Business Managers

The data can be used to indicate the severity of the discrepancies and suggest appropriate course of future managerial action. For example, most university schools exhibit relatively flat, loosely coupled, well defined internal boundaries that are permeable to negative feedback (structure maintaining) and impermeable to positive feedback (structure creating). Self organizing change in response to perturbations from the environment is slow.

While the market orientation value in Table 1 tends to scale well in the university schools of business studied, scaling of values across the system and the ability to respond effectively to environmental change could be improved by focusing upon the boundary conditions within the system. More tightly coupled boundaries with improved permeability toward positive feedback would likely result in an organization that maintains a better fit with and response to a dynamic external environment.

CONCLUSIONS

The study demonstrates that chaos theory can be used in conjunction with non-temporal data to yield valuable insights into the functioning of organizational systems. The theory of complex dynamical systems was shown to be applicable to university schools of business and other business organizations. Although the data set was drawn from a sample of AACSB accredited schools of business, the techniques of analysis are not specific and thus can be generalized to other complex dynamic organizational systems which include business and marketing organizations. The value of the study is to suggest new ways that chaos theory can be useful in the design and management of business and marketing organizations. The authors believe the analytical approach can be extended to for profit business organizations and other types of nonprofits. It would also be fruitful to investigate specific managerial actions that might be suggested by the data.

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APPENDIX

Survey Questions Sent to Marketing Department Chairs, Business School Deans, and Academic Vice-Presidents of AACSB Schools of Business Administration and Corporate Business Managers

1. Our objectives are driven by satisfaction of our students.
2. We measure satisfaction of our students systematically and frequently.
3. Those responsible for recruiting students regularly share information within our business school/institution concerning competitor's strategies.
4. Our market strategies (such as recruiting and retention) are driven by our understanding of the possibilities for creating value for our students.
5. We respond rapidly to competitive actions that threaten us.
6. We constantly monitor our level of commitment and orientation to students.
7. University administration regularly discusses competitors' strengths and strategies.
8. All levels of administration understand how the entire institution can contribute to creating value for students.
9. We give close attention to service of students after enrollment.
10. Our strategy for competitive advantage is based on our understanding of our students needs.
11. We encourage other staff and faculty outside of recruiting/administration to meet with our prospective students and their parents.
12. All of our departments are responsive to and integrated in serving students.
13. Information on recruiting successes and failures are communicated across functions in the business school/institution.
14. We share information and coordinate resource use with other units in the institution.
15. We target potential students where we have, or can develop a competitive advantage.

Each question answered on a 7 point scale: 1=Not At All, 7=to An Extreme Extent. Questions 1, 2, 4, 6, 9, and 10 relate to the Customer Orientation construct/dimension, Questions 3, 5, 7, 11, and 15 relate to the Competitor Orientation, Questions 8, 12, 13, and 14 relate to Organizational Coordination. The Overall Marketing Orientation score is computed by averaging the mean scores of the other three sets of questions.

NOTES