Chaos Theory as a Framework for Studying Information Systems

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This paper introduces Chaos Theory as a means of studying information systems. It argues that Chaos Theory, combined with new techniques for discovering patterns in complex quantitative and qualitative evidence offers a potentially more substantive approach to understand the nature of information systems in a variety of contexts. The paper introduces Chaos Theory concepts by way of an illustrative research design.

INTRODUCTION

The past decade or so has witnessed considerable discussion around the study of information systems (IS). There have been a number of initiatives that have attempted to introduce theories and frameworks that might inform our understanding and research in IS (e.g. see Giddens, 1984; Nissen, Klein, & Hirschheim, 1991). Most of these initiatives have come from those who have been dissatisfied with the narrow technical conceptions of IS research. There have been repeated calls to address the social and organizational issues with respect to IS (e.g. see the collection of papers by Boland & Hirschheim (1987). It has been argued that although the discipline has sought to address the social and organizational issues, there has been a shortage of well grounded theory and methodology on how to address these aspects (see Walsham & Han, 1990). Although in recent years there have been some attempts to fill this gap; we have as yet not been able to identify an appropriate theoretical basis for the study of information systems.

This paper introduces Chaos Theory as a means of studying IS. The paper uses the concepts to reflect on the nature and significance of IS. It is hoped that understanding the underlying assumptions and theoretical constructs through the use of Chaos Theory, will not only inform better research design for studying information systems but also help practice in understanding the intricate relationships between different factors.

The paper is organized into five sections. It begins with a description of the research problem and the approach. It then sketches out the manner in which Chaos Theory views information systems. Implications for research and practice are presented in section 4. Finally key messages in the paper are identified and broad conclusions drawn.

THE RESEARCH PROBLEM AND APPROACH

The Problem

It has been argued that an assessment of a particular discipline must proceed with an implicit or explicit understanding of what the discipline is and how it develops (see for example Banville & Landry, 1989). In the domain of IS there is a problem both with the manner in which we have studied IS and also with the theoretical basis that have been adopted for their study. More often than not, IS researchers have been involved in ‘academic demolition’. This has resulted in an inadequate analysis of the basic premise on which a theory is based.

One of the more exciting developments in studying IS in recent years has been the use of Structuration Theory (Giddens, 1984). It is the seminal work of Walsham (1993), that has brought the Structuration Theory concepts within easy reach of IS researchers. Walsham uses Structuration Theory to
augment the richness afforded by contextualist analysis of managerial situations. Earlier researchers (e.g., Madon, 1991) have shown that the Contextualist approach of Pettigrew (1985) falls short on a number of counts. The foremost limitation of Pettigrew’s approach is the lack of emphasis on the connection between what he terms the outer context and the other contextual levels. Although the use of Structuration Theory and the notion of Agency in IS research has been advocated by Walsham, it could be argued that the work tends to focus primarily on the internal organizational politics and procedures. In that respect Structuration Theory has been applied to IS in a similar way to its use by other management theorists (viz. Ranson, Hinings, & Greenwood, 1980). Indeed there is little analysis of the changing markets and government regulations; of managerial legitimacy which may consider issues of ‘gentlemanly’ conduct, ‘scientific’ approaches that may legitimize key perspectives, norms and procedures and friendship (see Giddens, 1973, p171). A fuller discussion of the manner in which Structuration Theory can been used in IS research appears in Kawalek (1997).

It is beyond the scope of this paper to present a comprehensive review of the dominant theories that have been proposed for studying IS. The brief critique of Structuration Theory, was to illustrate the problems inherent in the study of IS. The inability of theory to afford a comprehensive analysis does not necessarily suggest the limitation of the concept itself. As Walsham himself writes: “theory is both a way of seeing and a way of not seeing” (Walsham, 1993; p6). Therefore what we need are theoretical concepts that help us to view problem situations from a multi-faceted perspective. Clearly most theories used in current IS research seem to address a particular kind of a problem. In many cases the original intention of the researchers was to use one theory as a means to analyze particular issues. But we cannot assume that all problems related with IS can be handled by one particular theoretical concept. It will be argued below that the nature of IS and their role within organizations affords them being studied at multiple levels. In conducting this argument we propose that Chaos Theory affords a meta-theoretical conceptual basis on which to carry out such studies. Before developing this argument further we present two viewpoints that have been prevalent in studying IS.

Conceptions in IS Research

The purpose of this section is to highlight the extent to which the current approaches for studying IS have either a “Mechanist” or a “Vitalist” conception (Checkland 1981). The term Mechanist is used to summarize the rational constructs used by many researchers in studying IS, in the context of other business topics, taking the stance of ‘information technology applied to business’ (Stacey 1991). Vitalist is used to summarize those approaches to studying IS that start from the subjective viewpoints of the human actors involved, without any contextual constructs or assumptions. Although many approaches can not strictly be confined to either of the two poles, yet a discussion on the ontological and epistemological beliefs will help us in critiquing orientation towards a particular dominant paradigmatic thought. The demarcation between Mechanist and Vitalist perspectives is based on the way in which the functioning of organizations is considered. If the presumption is that all change is within a given social structure, it is Mechanist in nature. If we presume that all change is as result of a changing social structure, then we would consider it to be Vitalist in nature. While Mechanists have a unidirectional vision, Vitalists dwell on the assumption that some unknown or invisible property (or properties) determines the behavior of entities in the system. Hence they are opposed to the manner in which Mechanists look at local interactions within an organization to postulate the emergence of some global property (see Figure 1).

Mechanists and Physicists seem to have similar ontological roots. Hence they view reality to be independent of and external to human consciousness. Such a viewpoint has consequences to the manner in which IS are generally conceived. More often than not, Mechanists would consider IS to be socio-technical artifacts. Because of the intrinsic belief of Mechanists in the immutable laws of causality, they seem to consider IS in terms of intricate interactions and relationships. Hence they lay a lot of effort in predicting the outcomes when technology based systems are put in place. In terms of studying IS, researchers with a dominant Mechanist conception often have an over-reliance on traditional mathematics and logical tools to analyze and predict social phenomena, often to the limits of absurdity. Mechanists use mechanical or biological models to understand organizations, hence many of the socio-political aspects affecting IS, such as resistance to change, are considered consequences of ignorance at best and dysfunctional behavior at worst.

Figure 1: Mechanist versus Vitalist conceptions in studying IS

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The Vitalists on the other hand consider IS as social constructions that derive from the intersubjective experiences of human actors. Therefore they find coherence in the shared meanings of the organization. Vitalists make no claim to any form of objective knowledge. In fact given the complexity and idiosyncrasy of human experience, the vitalist metaphysics implies that there are no universal laws of causation in the social world waiting to be discovered and harnessed through the scientific method. This is more so the case with respect of IS. The Vitalists therefore propose that one should put their intellectual abilities to task in comprehending the essence of socially constructed subjectivity of information systems rather than wasting them manipulating the fictitious causal rules of success, say for developing IS. As opposed to the Mechanists, Vitalists do not see organizations as coherent structures with an agreed set of goals. Rather, they see organizations as a conglomerate of various interest groups that pursue a suite of goals that may not necessarily be in resonance with one another or with the organization at large. IS therefore are considered as fulfilling intentions of different interest groups, rather than the corporate good.

Chaos Theory as an Approach

Traditionally IS researchers are divided in terms of having a dominant Mechanist or a Vitalist stance. A Chaos Theoretic perspective attempts to bring together the Mechanist and Vitalist conceptions. In that sense Chaos Theory itself represents the beginning of a new science. As Peters (1991) suggests “Chaos breaks across the lines that separate scientific disciplines. Because it is a science of the global nature of systems, it has brought together thinkers from fields that that had been widely separated.” (p5).

The origins of Chaos Theory can be traced to the work of Kovalevskaya in 1889 when she proposed the mathematical definition of dynamic instability (see DeGrauwe, Dewatcher, & Embrechts, 1993). This work was later enhanced by Poincaré in the late 19th century to study planetary motion. In 1920s two French mathematicians, Julia and Fatou, used the original concepts to study unusual geometric shapes. In the 1970s this led Mandelbrot to generate chaotic fractals. These were then applied to analyze seemingly random, historical cotton prices. The analysis provided clear evidence that it was possible to identify similar patterns of changes in prices in different periods of time. More recently Chaos Theory has been used to examine the behavior of stock and bond markets (Radzicki, 1990) and exchange rates (DeGrauwe et al., 1993).

So what is Chaos Theory? It refers to an emerging scientific discipline which focuses on the study of non-linear dynamic systems (e.g. see Gleick, 1987). A non-linear dynamic system is one where any relationship between time-dependent variables is non-linear. Non-linear dynamic systems can be defined in terms of their equilibrium state. This is because any dynamic system is expected to be in a particular state of equilibrium at a given time. Comprehending the nature of the equilibrium state helps in identifying the hidden order in apparent chaos. These systems have three types of equilibrium: stability, explosive instability and chaotic equilibrium (e.g. see Ruelle, 1988 and Figure 2).

A system is said to achieve stability when it is controlled by a negative feedback. In such a situation, after experiencing all the changes, a system achieves a new equilibrium position. In understanding the nature of a stable system, distinction needs to be made between the actual state of the system and the desired outcome. Any discrepancy between the two states motivates action. Such actions result in bringing the actual state in harmony with the desired state. If corrective action is delayed, the system will begin to fluctuate. This type of behavior is experienced quite frequently in organizations (e.g. a factory needs time to produce widgets before replenishing stock) (e.g. see Stacey, 1991, Radzicki, 1990).

A system achieves explosive instability when it is driven by a positive feedback. A positive feedback reinforces the initial change made in any of the variables. Such small changes accumulate exponentially over a period of time and may result in an explosive situation. Situations representing explosive instability often render forecasting impossible.

A system is said to be in a chaotic state when there is the simultaneous and unbalanced presence of positive and negative feedback. Negative feedback play the role of maintaining stability by countering initial changes while positive feedback tend to reinforce the initial change in an attempt to increase instability. A situation may give rise to three kinds of outcomes, the first two of which are predictable behaviors and the third being chaotic. First, when independent of the time dimension, a system reaches an equilibrium state. This is called the point attractor. Second, the system may periodically arrive at an equilibrium state. This is called the periodic attractor. Third, it may seem that the system is behaving erratically. The erratic behavior would be dependent on the initial changes and the interplay of negative/positive feedback. This is termed as a strange attractor (see Figure 2). The strange attractor represents a situation which has been termed as deterministic chaos (i.e. the attractor is creating new order in the apparent chaos) by many Chaos Theoreticians. Clearly it is characterized by non-repetitive and non-predictable fluctuations that arise because of the concurrent interplay of negative and positive feedback loops. Deterministic chaos characterizes the nature of most organizational and social systems, i.e. dynamic systems governed by non-linear relationships (Thietart and Forgues 1995).

Chaos Theory therefore could offer interesting insight into the analysis, design and management of information systems. Given a particular stage of information systems development, a certain facet of Chaos Theory can be used to interpret the possible consequences. In general a chaos analysis will indicate whether prediction is at all possible. Since in reality a large number of factors come together to determine a possible outcome, Chaos Theory offers an easy means of
A simple negative feedback loop

**Figure 2: Nature of a chaotic system (in part incorporated from Radzicki, 1990)**

A potentially chaotic situation (strange attractor)

Contextual information

ACTUAL STATE

PERCEIVED STATE

information about actual state

actions

DESIRED STATE

Point attractor

Periodic attractor

Strange attractor

A CHAOS THEORY VIEW OF INFORMATION SYSTEMS

The purpose of this section is two fold. First, to identify those aspects of an IS that make them worthy of being considered from a Chaos Theoretic perspective. Second, to show through an illustrative example the applicability of Chaos Theory concepts in studying IS.

Chaotic Nature of Information Systems

Our proposed use of Chaos Theory in IS research is based mainly on the following three assertions. First, that the long term future of IS is inherently unpredictable. Second, predicting outcomes of change caused by IS is virtually impossible. Third, the notion that IS success is a function of adaptation to the environment is too simplistic. Table 1 gives a few examples to support these assertions. Chaos Theory has a lot to offer in terms of studying information systems because its principles address aspects of the assertions identified above. The following paragraphs explain these assertion in detail.

IS within organizations rarely represent an equilibrium state. This means that scarcely detectable disturbance in an analysis; design and implementation can potentially get amplified to change the total behavior of a system within a very short period of time. This is exemplified in research by Dhillon (1997). He shows how a small irregularity in the design of a clinical information system resulted in human relation problems within the hospital. Such problems eventually affected the integrity of the whole organization. It is clearly impossible to forecast such irregularities so as to take considerable vigilance in detecting any disturbance. Therefore all exercises in simulating long term behavior of systems experiencing ‘chaotic dynamics’ is pointless. Since the number of long term outcomes are going to be infinite, any number of manageable simulated scenarios are not necessarily going to approximate the actual situation.

One of the implicit observations in the Dhillon (1997) study was that small disturbances in the organizational setting

Table 1: Some examples of the reasons for such assumptions

| 1. | The rapid rate of change of the underlying information technology, the variety of applications that can be created and the effects on individuals, organizations and society makes prediction extremely difficult, even in the short term - the Internet being the latest unpredictable “phenomenon”. Indeed, some IT suppliers see their route to success in “producing chaos” in the market (Protesch, 1993). |
| 2. | The organizational and business environments within which IS are conceived, designed, implemented and used, are themselves ever changing “systems” which contain their own degrees of chaotic behavior (as argued by Thietart & Forgues, 1995 and Parker & Stacey, 1994). Whilst IS development lead times are shortening, there are no ‘instant solutions’ which would overcome at least the time related problems, by reducing the gap between problem definition and solution realization. |
| 3. | How individuals and organizations use information in decision making and evaluation is neither entirely rational nor consistent. Information when used is affected by contextual and situational factors, which cannot be pre-specified. ‘Point attractors’, ‘Periodic attractors’ and ‘Strange attractors’ can all be identified in how information affects individual and collective decision-making. |
took a long time to get amplified. This means that although long-term prediction of systems’ behavior is a far-fetched idea, short-term forecasting is not. Therefore by managing the small term behavioral disturbances and IS impacts, it is possible to manage the emergent chaotic situation. Chaos Theory proposes that there is always a hidden order in chaos. The order within an organization can be interpreted at two levels. First, at a micro level by interpreting small causes and effects. Second, by taking a more vitalist stance and interpreting the dynamics at a macro level. Analysis at these two levels will help in understanding the hidden order, which is inherent in the structure of the rules generating the behavior (i.e. the degree of irregularity in a specific behavior). Indeed there is little research to suggest why particular outcomes take place, which are based on events, apparently disconnected from the prime purpose.

A Chaos Theoretic perspective in business management takes a very radical viewpoint. It asserts that it is impossible to manage any major change in terms of its long-term specifics. This is because of the inherent unpredictability of such outcomes. It follows therefore that any outcome of a major information technology related intervention could not be assessed adequately. Moreover it will not be possible to control any specific aspect of information technology related change. At the most an environment conducive to change can be developed. This was illustrated in the case of the London Ambulance Service computer aided dispatch system. The grand designs of the system developers resulted in a complete project failure and abandonment of the system. While analyzing the outcomes of the system, Beynon-Davis (1995) notes that one of the primary reasons for failure was the complexity inherent in system design. Those in-charge of the system developmental activities had a vision of controlling all possible outcomes. They failed miserably.

The analysis of information systems related change from a chaos theoretic perspective means that our focus should not be exclusively on controlling outcomes. Rather emphasis should be placed on the processes that lead to an outcome. In doing so the notion of grand control translates into ‘control over the process of discovering’ in an actual setting. Although this concept is at the heart of most risk analysis approaches, it is rarely used adequately.

Mainstream literature in business management suggests that in order to achieve success, a system must adapt to its environment. The notion of an environment is however confusing. In fact any one system may act as an environment of another system. This could possibly result in a sequence of events that have a chaotic affect on the behavior of all other systems. In this respect, the environment of a system should not be considered as given, rather it is consequence of interactions between different systems. It is therefore difficult to suggest a clear cause and effect relationship between a particular system and its environment.

A good example of dynamicity of the environment and its relationship to particular activities in a system can be found in the work of Kumar & Willcocks (1996). While considering outsourcing options available to Holiday Inns, Kumar and Willcocks show that although the options available appeared straightforward, environmental influences introduced a fair amount of complexity in the decision making process. Initially, because of the internal disturbances within the organization, Holidays Inn had decided to bring in programmers from India, however unpredictable complex contextual influences adversely affected the decision process. Regulatory requirements and economies of scale tilted the final decision towards offshore outsourcing. The Kumar and Willcocks study showed that there appears to be no straightforward cause and effect relationship between the rational decision to outsource and the actual realization of the outcome. This means that a good decision based on achieving an equilibrium state may not necessarily lead to success. In fact such equilibrium can never be achieved. This is because the environment within which the equilibrium is sought is itself constantly changing.

**Studying Information Systems: An Example**

Since information systems within organization are characterized by such dynamicity and turbulence in the environment, it seems obvious the Chaos Theory offers us with relevant concepts to analyze, design and manage information systems. The question that may be asked at this juncture is: what do we do with the concepts of Chaos Theory? There are three possible directions. First, the Chaos Theory principles and the other related concepts can be used qualitatively to interpret current situations. This can be followed by reflexively thinking about all possible scenarios. Second, a more quantitative approach can be adopted, where various factors can be identified for a particular situation. This can be followed by a qualitative analysis of various relationships among the factors with the intention of generating some dominant patterns. Different levels of complexity can be maintained in this process, there could be a simple cluster analysis or more complex forms of attractors could be generated. Third, a combination of qualitative and quantitative methods can be used. The aim of this section is to illustrate the use of Chaos Theory principles in conducting research.

**The Context of the Example**

The research design described here was developed to undertake a detailed study of 11 cases of Strategic Information System (SIS) applications. The aim of the study was to examine the possible reasons for the relative success or failure of particular applications. Taking a more holistic approach than previous work identified various factors. This was in terms of its consideration of the whole application life cycle and the range of process and context factors included to fit the definition of Strategic Information Systems (more details about this can be found in McGolpin, 1996). The study was carried out in 4 steps:
1. A review of literature and initial fieldwork to elicit factors which were deemed to affect the degree of success in IS investments. This was based on the stages of an application life cycle (planning, evaluation, implementation, and benefits realization).

2. Main field work where 11 detailed case studies were conducted. The choice and conduct of the case studies was guided by suggestions in Yin (1984).

3. Conventional quantitative analyses, using appropriate statistical techniques, were performed on the data, to identify factor inter-relationships.

4. The data was also analyzed by adopting a Chaos Theory perspective, qualitatively, using pattern matching software, to determine whether/which factors could be demonstrated to be significant across the range of degrees of success (i.e. an evaluation of the emergent structures, see Figure 1).

Given that nearly 50 factors were identified, each of which could have a range of values/attributes, both numerical and descriptive and 11 case studies were involved, there is no space in this paper to describe the factor attribute analysis in detail (see McGolpin and Ward 1997).

An Illustration

The research design described here identified 4 levels of SIS success - High Success, Success, Moderate Success and Unsuccess. The measure of success defined for this work was based on obtaining an agreed senior management view of the success, based on their perceptions and documented evidence of the extent to which the expected benefits were realized or exceeded.

‘Expected benefits’ means those benefits, which were used to justify the investment.

The conventional analysis based on statistics revealed a number of simple correlations, which clearly distinguished factors, related to High Success and Unsuccess. In reality, factors affecting the two extremes of success were readily distinguishable in the data and this analysis confirmed their significance. However it could not with any reliability determine differences between the other levels, nor identify related combinations of factors across the life cycle, thereby providing any explanation of the causes of the levels of success. This is a typical example of a situation where the study of ‘local interactions’, although important, does not necessarily give the complete picture.

With respect to the research design presented here, a simple case based analysis did not provide much insight either. Pettigrew’s (1985) contextualist approach was used to collect the data. Although the theory used provided deep understanding of particular situations, e.g. the identification of certain socio-political issues, it fell short of providing an understanding as to which factors, in which combinations across the life cycle, came together to make an IT application highly successful, successful, moderately successful or unsuccessful. This supports the assertion made earlier in the paper, that most theories currently being used in IS research help in addressing only certain facets of the problem. It is our assertion that Chaos Theory provides an overarching conceptual framework that will help in organizing the research process.

In order to analyze the emergence of some relationships, the research design used the pattern matching tool - netmap. netmap is a set of computer programs, which identify and analyze formal and informal networks amongst data - both quantitative and qualitative in nature. It also produces a graphical; easy to interpret representation of the clusters identified. Its emphasis is on the analysis of patterns and relationships across large volumes of data. An integral part of the netmap software is an analytical tool called Emergent Analysis. This tool was ideally suited to map out emergent relationships as complexity is added to the data set. This meant that it was possible to limit the relationships for generating patterns to a desirable level and subsequently trace the emergent complexity.

The ability to understand the patterns as different factors related themselves, shows the complexity that is inherent

Figure 3: From local interaction to emergence–a typical example
in IT projects. Clearly there is no single set of factors that determine success. In fact there are particular combinations of factors that would determine differences when moving from one level of success to the other. Figure 3 mirrors figure 1 to exemplify the emergence of the intricate relationships between factors that determine the different levels of success (Note: the contents of the analysis, i.e. the details of the factors, have been excluded from this illustration).

Figure 3 shows how traditional statistical analysis provided a limited understanding of the relationships. In many ways it suggests that if the problem domain is inherently complex, majority of the statistical techniques will perhaps prove the obvious. It is limitations such as these that have been used by anti-positivist researchers to critique predominantly mechanistic explanations.

Figure 3 also shows three levels of an analysis. Stage 1, as mentioned earlier gave a simple explanation of a significant distinction between those factors that differentiated between High Success and Unsuccess. Stages 2 and 3, through the use of the NETMAP tool, helped to generate progressively emergent scenarios. Stage 2, to some extent, mirrors a simple negative feedback loop (see figure 2). Clearly the analysis took the form of a closed feedback, with little contextual influence. Interesting results emerged when the contextual influences were added (stage 3). In the second stage where the contextual influences had been ignored, analysis revealed that there was a distinct difference between factors determining success and all other levels of success. However as the analysis proceeded to stage 3, where contextual factors were included, a different picture emerged. It was not possible now to differentiate between success and moderate success indicating that only systems development life cycle process and not contextual factors explain the difference but it is only contextual factors, external to the process, that differentiate High Success from Success. This means that had a simplistic approach been taken while conducting the analysis (i.e. analysis at any one level), the findings would have been incomplete and an inadequate explanation of the factors affecting the range of levels of success.°

Although we have presented a simple illustration of the complexity in research designs, it does make a point about the inherent chaos in actual situations. It also shows the emergent nature of a problem domain and how regular patterns can be identified, such that some order can be found in a potentially chaotic situation.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The previous sections have explained the concepts in Chaos Theory and have made suggestions as to how these could be used in studying IS. The foremost intention of these sections was to show the richness in adopting Chaos Theory as a conceptual framework. In many ways Chaos Theory offers us with a high level meta-theoretical framework. It does not suggest any one particular technique, but since the main argument is to interpret order in chaotic situations, the theory does imply restrictions in choosing analytical methods, i.e., they should be non-linear.

In the literature there has been a lot of debate about bringing together quantitative and qualitative approaches (e.g. see Gable, 1994). The intention of such discussions has been to suggest the restrictive nature of research if one is strictly confined to one or the other approach. Clearly there is value in bringing together different viewpoints. There is however a more substantive task of understanding paradigmatic orientations. In the Burrell & Morgan (1979) tradition, it is virtually impossible to bring together the two opposing kinds of methodological approaches. This is because they differ in terms of their ontology, epistemology and an understanding of human nature. The four fold classification of Burrell & Morgan (1979) - functionalism, interpretivism, radical humanism, radical structuralism, suggests that if a researcher is rooted in a particular paradigm, he/she will fail to consider the value and relevance of approaches rooted in another paradigm.

Chaos Theory, which does not have sociology as its reference discipline, addresses an issue that has only recently been considered important in sociology. Reference here is being made to the bringing together of different paradigmatic thoughts through meta-theorising (e.g. see the work of the American sociologist Ritzer, 1992). Ritzer, for example, is opposed to the paradigmatic divide advocated in works such as that of Burrell & Morgan (1979). He attempts to bring together philosophically divergent tool sets. Chaos Theory has always worked on this assumption. Many management theorists have taken on board the Chaos Theory concepts in their attempts to explain the complexity in organizational situations (e.g. see Thietart and Forgues 1995).

With respect to the discipline of IS, Chaos Theory is of value on two counts. First it can explain the chaotic nature of IS within organizations. Hence it comes in handy for a researcher to conceptualize about the problem domain. Since the goal of Chaos Theory is to find the hidden order, it introduces a structure and a purpose on the thinking of a researcher. One of the major criticisms of approaches in the more interpretive tradition has been that of rigor (although Walsham, 1995b; 1995a argues otherwise). Chaos Theory helps in overcoming this criticism.

Chaos Theory also holds out promise for practitioners. Often managers are confronted with situations where they may have to predict consequences for the future. Given the combination of the chaos inherent in the development and operational environment of IS and the complexity of sociotechnical systems, such predictions is not always easy. Even when predictions are made, the actual outcomes may not take the desired form. This questions the value of prediction and often confuses managers during their decision making.
process. We argue that by adopting a Chaos Theory orientation during systems design and development, for example, will help managers to understand the limits of predictability and the factors, which will interact and affect the eventual outcome.

CONCLUSIONS

Researchers venturing onto new research projects often face three sets of issues. The first is related to understanding the nature of the phenomena or problem at hand. The second concerns the choice of theoretical and practical approaches to address the problem and the third relates to the analysis and interpretation of the data and observations to ascertain legitimate conclusions from the evidence available. The concepts presented in this paper help us to address all three issues.

The majority of IS research to date has generally either sought to draw conclusions from simple statistical analysis of inevitably incomplete samples of quantitative data, or from detailed interpretation of a small sample of case studies representing unique situations. Chaos theory, combined with new techniques for discovering patterns in complex quantitative and qualitative evidence offers a potentially more substantive approach to understanding the nature of IS in a variety of contexts. We have argued that IS are developed and managed in chaotic environments, both business and organizational and that the processes of IS development and use are also inherently chaotic. Hence it would seem that by adopting a Chaos Theory perspective we could begin to study and perhaps understand the phenomenon more appropriately.

ENDNOTES

1 ‘Academic demolition’ is a term used by (Burrell & Morgan, 1979) to describe attempts in critiquing theoretical standpoints. This is normally carried out by evaluating consistency of assumptions from the point of view of one’s own problem area. Various authors have rejected academic demolition and have stressed the importance of understanding the nature of assumptions that underwrite one’s point of view.

2 Many authors have used terms such as Complex Systems Theory, Complexity Theory, and the Dynamical Systems Theory to refer to chaotic phenomena.

3 Although complex computations and pattern generation could always be carried out mechanically, but ever since the advent of electronic computers, it has become easier and quicker to carry out the computations.

4 The correlation coefficients were subjected to a t-test to check statistical robustness (defined as t = *sqrt(n-2)/sqrt(1-r^2)) by Lloyd, 1984). A multiple analysis technique, canonical analysis, was used to analyse relationship between two sets of variables.

5 The detailed data and the results of the analysis for the study described here run to some 90 pages of data, 40 tables and 28 cluster diagrams.

6 These are just examples of the, often very specific, conclusions that were drawn from the many analyses carried out.

REFERENCES


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