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Chaotic Disorder and Performance in High Velocity Environments: Some Coping Strategies

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CHAOTIC DISORDER AND PERFORMANCE IN HIGH VELOCITY ENVIRONMENTS SOME COPING STRATEGIES

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I. Measurement Error in the High Velocity Organization/High Velocity Environment

According to Brown and Eisenhardt (1997), high velocity environments present phase shifting competitive pressures that force rapid fluctuation and adjustment in rapidly pacedcompetition. Brown and Eisenhardt (1997, 1998), Eisenhardt and Bourgeois (1988) identify hyper-competition and show it is just a temporary phase, but is resident in select industries. Example industries for the purposes of this paper are information technology, software development and marketing, cloud computing, application development, and tech innovation sectors who all exhibit perpetual states of change. In fact, you might say that all of these companies and industries are in a constant struggle to "become something else."For example, the New York Times (October 19th, 2012) suggested that the product life cycle of a telephone or computer app is about 35 days. In this world, competitive advantage or value creationat the product or divisional level is at best fluctuative, and at worst poor, nasty, brutish, and short with a scedastic function. Hence, high returns of even stable leading performance indicators cannot be based on sets of resources or competencies, but must be measured in the granular metrics of performance and placed into non-linear regression modeling. These types of environments are resonant of the Schumpeterian creative destruction of *status quo* in light of frequent and significant changes to strategy execution *ex-post-facto* by necessity or proclivity.

The prevalence of high velocity environments is evident and the necessity of increasing the speed with which companies assess their competitive environment, develop new products. Literature (e.g. Dimancescu and Dwenger 1996; Meyer 1993; Stalk and Hout 1990; and Vodosek and Sutcliffe, 2000) identifies the speed at which companies bring their product to market as one of the most critical issues today while exemplifying product development cycles in tech companies like Apple Computer or Google who face those innovation periods of 35 days or less to conceive, prototype, and file patent for innovative products. Empirical studies appear to support this contention. For example, Eisenhardt and colleagues (Bourgeois and Eisenhardt 1988; Eisenhardt and Tabrizi 1995; Schoonhoven, Eisenhardt, and Lyman 1990) have looked extensively at the effect of speed on competitiveness of companies in these environments. They found that fast decision making by management based on rich real-time information (Bourgeois and Eisenhardt 1988) is closely linked to high velocity performance, however the risk of Type I, Type II, or Type III error (that is, working on the wrong problem) increases. These accounts provide evidence that rapid cycle organizations operate in an *"aetateceleritate"* which requires them both to make decisions faster and to implement them more quickly (Vodosek and Sutcliffe, 2000). Finally, according to Eisenhardt (1986) agents will competitively pursue their own interests under a variety of conditions like escalation of commitment to a current strategy. Agentswill compete with one another over anything with positive valence like money or some other extrinsic or intrinsic reward (Peterson, 1997).

In terms of mathematical modeling for this type of environment it is interesting to note that it has been around for a long time. Richardson (1960) developed a

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mathematical model for the performance variance of managerial outcome situations, which Mayer-Kress (1992) analyzed, noting that the Richardson model was an extension of the logmap $x^t+1 = x^t - K^{21}(x^t - x^0) + K^{22}(1\text{-}x^t)$. $y^t+1 = y^t - K^n(x^t - x^0) + K^{n+1}(1\text{-}x^t)$ where *x* and *y* would be the expenditures of the two divisions, K^{21} and K^n are forces that control their activities to pre-performance period levels, and K^{21} and k^{n+1} represent the speed of the growth in the trajectory. Mayer-Kress (1992) found that the measurement remained stable if the arc of the trajectory K^{21} and K^{n+1} remained below a hypothetical value of 3.0. If either parameter exceeded 3.0 the system went into chaos immediately, and did not stop at the intermediary oscillation (Guastello, 2006). Quicker managerial reactions were required and possible. Interestingly enough, it *would* be possible through the three party solution by Poincare (1905) to extend the model to *n* systems and to *n+2*, systems involving ∞ types of companies and operations. With nonlinear regression, it would also be possible to compare oscillatory phases for predictive points to determine more and less salient predictors of performance. There are other constructs that bring attention to chaotic situations. For example, agent-based models illustrate how individuals working as agents, and in their own self-interest, produce self-organizing systems consistent with the desires of other stakeholders (Eisenhardt, 1989). According to Russell and Faulkner (2004), agency based self organizing systems can manifast sudden and discontinuous changes known as *phase shifts*, in light of unpredictable events, cognitive dissonance, disagreement, environmental turbulence, or board directives. These phase shifts discussed in the next section move toward the tone, scope and state of the dynamic space while presenting chaotic and coping mechanisms.

II. Phase Shifts

Figure 2 shows implementation A with phase shifting toward strange attractors. It's this phase shifting that causes a performance reaction in granular metrics. Figure 3 is the representation of the phase shifting between performance goals B^n and strange attractors S^n. Researchers seem to be in agreement that these environments require more responsive forms of organizing because of their chaotic quantum nature. Responsive organizations are characterized by sensitiveness to environmental stimuli and ability to act quickly. Responsiveness in this sense doesn't simply mean reacting quickly, it also means having the data and the response plan as event micro-phase information provides leading indicators to rapid managerial activity. Not doing so, or missing event horizons is the nature of what this paper calls *Corporate Attention Deficit Disorder.*

The early and mid-1990s were the start of some relatively serious inquiry into the organizations sciences and chaos with the journal *Organizational Science* taking a leading role in inviting and disseminating scholastic research. Approaches like chaos and conflict (Guastello, 1996), and organizational integration of chaos suggest that conflict breeds self organization through disonic and iterative processes. From these studies and from the mathematical modelling, we can isolate some patterns inherent in chaotic situations where outcomes are rapidly changing. We can also discover a self organizing portion of chaos that brings predictability followed by the restatement of chaotic and quantum patterns as predicted by relative real-time measurement *attention to performance* and performance itself. A theme is that not all organizations pay continuous attention attention to granular data in certain cases, these organizations with the CADD pathology could use a methylphenidate type intervention that speeds up organizational neurotransmitters and enhances cross hemispheric attention patterns.

III. Corporate Attention Deficit Disorder, Indications

While Figure 2 (above) and Figure 3 (above) show the results of inattention span and cyclonic through which inattention is actuated it is necessary to find a potential treatment for this corporate disease. According to the Physician's Desk Reference (PDR) *attention deficit disorder* is indicated or characterized as something that begins in an early stage of life and often continues into maturity. It is indicated by a persistent pattern of inattention, impulsiveness, hyperactivity, carelessness, abruptness, and high risk activities. In humans the condition is recognized as running in families. Similarly, the conditional metaphor could be said to run in industrial groupings, particularly in high velocity sector organizations, diagnosed through outward portrayal of industrial positioning and competition and organizational culture. In humans, the interventional process is typically to administer a methylphenidate while twinning that with talk therapy. In organizations, the metaphor could be extended to human resources development aided by the processes of continuous measurement and attention to informational, scale, volume, cost, and differentiation based competitive advantage, all helping to create the moderated CADD. It is important to remember that interventional processes are designed to assess and react to changing cultural distance while finding areas of adaptation potential and finding opportunities for potential for economies of scale through adding volume, decreasing costs, differentiating products and improving industry attractiveness. Firms must enact continuous recombinant strategies and actions to leverage their firm specific advantages in order to react to and benefit from

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the environment. A simple question is, "how often do they need to do that"? Figure 4 shows four strategies requiring differing amplitude and modulation of recombination.

a) Let's examine adaptive processes

High velocity organizations are those in the fast change and little changes section; they are filled with complexity and continuing tactical changes, it doesn't take into account the complexity and chaos in the environment that triggers necessary organizational adaptation of large environmental changes and self-organization. To use the parlance of the PDR or the Diagnostic and Statistician's manual of Mental Disorders, IV (DSM IV), one organization is that which processes slowly into varying states while adapting to the environment. The other is the type of organization that processes large environmental change quickly, moving from slow little change to fast large change when necessary and perhaps back again. A third is one that concentrates from one type of environmental situation and back again, rather like putting out fires in the forest while disregarding the pathologies of the trees. This is the CADD pathology.

b) Nonlinear Dynamic Systems Theory (NDST)

Working through the system dynamics that organizations face in a rapid velocity environment, we can turn to the NDST (Khalil, 1996), which consists of a group of mathematical concepts explaining how events might model the development of chaotic structures, depending upon their variability and the interrelationships with measured in real time performance. Simple NDST modeling techniques are used for the empirical explanation and prediction of a rapidly changing event. In this section, a demonstration of the NDST used to shape organizational structures and activities for evidence based performance improvement is highlighted.

This section should be interesting to even the most *arithmophobic* reader. Presented are simple and well understood methodologies from Poincare (1905), Lorenz (2005), and Lyapanov (1902). While the calculations would take days to complete by hand, these calculations can now be performed with elementary mathematical software including SPSS/PASW, SAS, Mathematica, or Python based systems. At the very base, we're looking for varying marginal differencesin outside decimal positions (at the 8th decimal or further) while looking at variations in $\sum$(period 2_r – period 1_r; period 4_r – period 3_r; to period ∞ - $(\infty\text{-}1)_r$, where *r* is the repeated measure in subdivided meter called an observational moment. Since this method becomes complex over a very large number of observational moments, we need to introduce structured equations that make for easier calculation and modeling. Consider the case in Table 1where we have some continuous variables that fit the following strategies (Hax, 2005):

We need an approach toward the analysis of the dynamics of a measurement path which determines the constant progression of marginal change. The measurement path should look rather precise, rather than a typical shotgun analysis of possibilities played out through linear modeling or games. In this process, we can rely on a small number of possible equations that we can test through nonlinear regression analysis where there are four basic models in a set where everything is a function of *e* (Guastello, 1996).

In consideration of the first several elements, Equation1 is a simple exponential function while Equation2 contains an unknown split variable that measures variance in granular performance and outcomes. Normally, the procedure would be to test both models while comparing $R^2$for Equation1, Equation2, and for a linear model. In Equation1, $z^2 = \exp(\theta^1{}_z 1) + \theta^2(1)$ where $\theta^1$is a nonlinear regression weight. θ^1 indicates the level of variable complexity and turbulence. If $\theta^1 < 0$, the time series is veering toward a fixed point attractor. This is like a Lyaponov(1902) measure because when $\theta^1 > 0$, measures are becoming more chaotic and can ascertain the presence of chaos. Equation1, with very large numbers of parameters, would be iterated over time and the outcomes measured up to the 8th to 10th decimals. At this granular level, chaos starts to show itself and the Lyaponov starts to vary above or below 1. Nonetheless, if we know z^1, it tells us what $z^2$is going to be even under chaotic conditions, assuming that the model fits the data. Johnson and Dooley (1996) showed that Equation1 provides reasonable estimates of fractals associated with data generated by the Lorenz and Rossler systems (Peitgen et al, 2006), which model chaotic attractors.

The second model in the exponential series contains an unknown bifurcation effect, which indicates the presence of a variable that affects the inflection of a curve:$z^2 = \theta^1 z^1 exp(\theta^2 z^1) + \theta^3$. If $\theta^1$is sufficiently large, we can observe oscillations, period doubling, and chaotic situations when we iterate the function. May and Oster's (1976) model for population dynamics, is a transformation of the Equationfor the logistics shown in Figure2.

The structural equations technique with nonlinear regression has been used in Peitgen et al (2006). Should we wish to use an application of a complement or system supplier to a computer assembly firm/retailer, software producer, game app inventor, semiconductor manufacturer, or any organization that depends upon rapid development of products the measurement of performance variables can represent desire to be a system-lock provider with prohibitive switching costs. The application of performance variables of customer switching costs, rate of product

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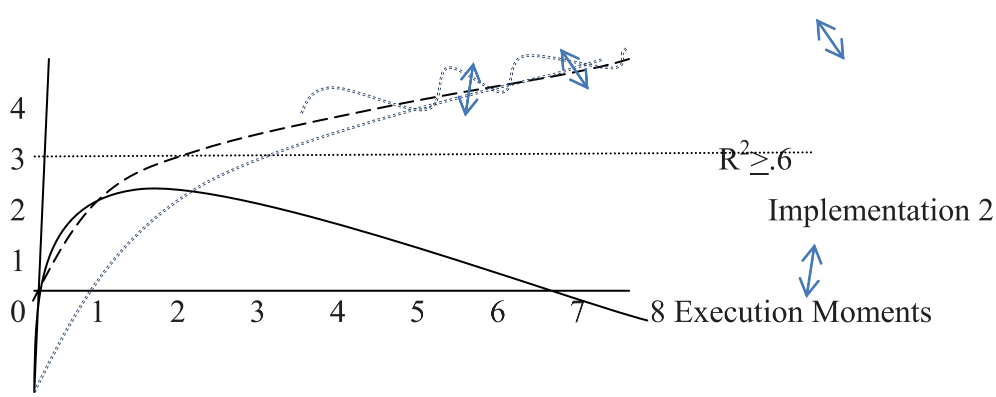
development, and competitor cost to imitate would be variables of interest as chaotic variances in the stability of measurement may show withering commitment or performance to a crucial element in the manufacturing or supply process. Additional application involving operational costs of performance, product innovation in competitors as well as production efficiency per unit are important. As they begin to vary widely over time and across market variations these measures become of great interest to the paper.

In example tech companies measures were taken from A/R, 10-K, and reliable media like the WSJ,FT, and from financial databases over the period 2001 to 2011. The widening of variance in the models are interpreted as predictor of chaotic structures in the short term, however should there be multiple numbers of measurable division variances within and across competitors as multi polarization effects take hold. These should complicate divisional objectives, but with concurrent observation it should be possible to react in a situation like that in Figure 2 and correct if CADD is not present or is controlled through the use of an organizational methylphenidate through the attention spanning role of the decision support system and analyst keeping track of very frequent measures.

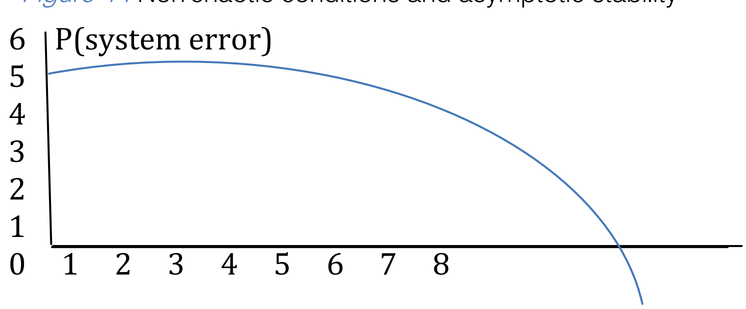
Should be results of Equation1analyses between measures be relatively accurate, $R^2 > .60$. The next step is to iterate functions into the future to see if they would produce similar, varying, or stable forecasts. In this case, the Lyapunov exponent (1902) would be positive (that is, chaotic) in both equations, with the two functions predicting some different futures. For Equation1there is a sharp and gradually increasing upward bifurcated trend with performance moving toward an uncontrolled state due to CADD and inaction.Equation2 predicts an upward blip, followed by a *drop* in bifurcation due to evidence based managerial action and the regaining of control. In one, there is a situation of attention and effective adaptation. In the other, there's a situation of managerial inattention, or Corporate Attention Deficit Disorder (CADD).These two futures are possible depending on managerial perception, surveillance and action. Please see Figure 3, just below.

5 Chaos Phase Threshold from 3.0 chaotic movement @ Implementation 1



As a point of clarity, the movement of performance into a chaotic state would be enormously expensive to manage and correct. This makes the case that a concurrent Lyaponov style measurement is necessaryfor both types, and a CADD oriented intervention becomes necessary. While the human subject might try a methylphenidate, it's not possible to administer it to an organization. So what can be done inthe CADD type organization?While there's an upwardly curved polar experience and a movement toward chaos, it becomes necessary to intervene with evidence based management, frequent measure and subdivided correction. With low numbers, however, a Lyapanov variable shows a movement toward non-chaotic conditions and asymptotic stability in terms of lowered system error and better execution. See Figure 4 just below.

Figure 4 : Non-chaotic conditions and asymptotic stability



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The next section considers a type of organization that can benefit from CADD training or development when non-CADD presents.

c) CADD Training and Development, Intervention and Treatment

The notion of CADD at the functional, business, and corporate level leads to the question of what dynamics could be involved within each group. Disagreement of choice or measurement can result in a polarization dynamic that makes correction difficult at best. Polarization is often connected to conflict in groups, either as a starting point, or as a high-water mark of the group's activities. While complex group dynamics are involved, the underlying processes are chaotic. Groups should often discuss their ideas, plans, and attitudes and find they have differences of opinion. In cases where the participants are not too emotionally involved at a personal level, they often find midpoints or compromise positions that are agreeable to most participants. If the topic or attitude target is "important," however, continued discussion will lead to polarization of group members, rather than compromise. Latane (1996) expressed the dynamics as a catastrophe model which is one model of a comprehensive theory of discontinuous events (Zeeman, 1977). The response surface shown in Figure5 shows the range of places that a system may occupy along a behavioral variable, *y*. The response surface contains some distinctive pleats or cliffs, however, and movement across those cliffs produces dramatic qualitative change. The shaded region represents the range of locations where the system is very *unlikely* to go; that is, the shaded region is a *repellor,* move away from it, instead of toward it as with an attractor. Figure 5 (adapted from Guastello, 2008).

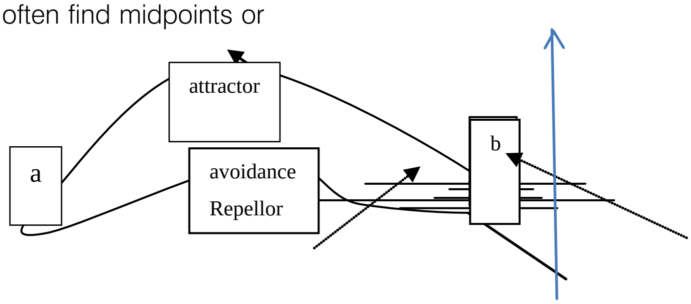

Figure 5 : Adapted from Guastello, 2008

There are two chaotic states (attractors *a* and *b*). The group begins at the unstable points, and also known as a saddle, on the surface and then converges into a saddle *y* as corrective action is indicated by evidence. This cusp model also contains a second control variable (asymmetry) that corresponds to the arrows in Figure5, which would govern whether a person would shift attitude toward one pole or another, or decide to join some coalitions for control. This is very easily transferable to the small and medium sized firm in a measure of fit of orientation to the asymmetry control parameter, with the attitude toward specific policies used as the behavioral response. Arguably, while these two constructs might be similar enough to be considered redundant, the cogency of the arguments from the group favoring one pole or the other could be influential on undecided people in much the same way as the perception of an ambiguous Figure is influenced by the quantity and direction of specific details in the drawing (Stewart & Peregoy, 1983).

Given that co-effort is important this model also indicates that people could waffle between the two poles before locking in to one attractor or another. The waffling process is more formally known as *hysteresis* which is the dependence of a system not only on its current environment but also on its past environment. This is depicted in a two-dimensional display in Figure6, *chaotic hysteresis*. Movement is evident between goals *"G"* and strange attractors *"S".* Outside of a control limit there are three basic pathways by which a system can become chaotic (Guastello, 2006). The first is an application of the three body problem that incorporates strange attractors.

The classic strange attractor between bodies, the observer or scientist must multiply the number of measurements of data relating to the attractor points (aka attracting events) and relevant strategic movements towards measured outcomes B(1-3). A strange attractor, S_n can be multiplied by the total attractor events however we want B(1-3) to be coherent in the enacted environment. There however are S (1…∞) attractors. These strange attractors create the out of control limit artifacts where many are due to random chance making the notion of control limits meaningless (Guastello, 1996; Guastello, 2006). In the case of CADD, the opportunity for action is that when a path enters the field it is pulled in different directions in unpredictable ways. Take the case of the innovative tech firms mentioned previously. They have products, technologies, individual goals for each, implementation plans and missions that address each individual product line. There is also information from the environment related to international news, economics, stakeholder pull, and stockholder demands with differing interpretive

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bases from which they address their knowledge acquisition and ability to phase from one state to another. Each of these attractors pulls from subject, body, and attention of the organizational adaptation at hand. There may be other chaotic circumstances pulling the audience to chaotic tendencies.While attractors may coalese within activities all attractors combinatorally do not. It presents the circumstance of minimizing variance of attractor gravitation toward scenarios that speak to the near and far term. An experiment reported in Puu and Sushko (2002) reported that odds of control were not enough to limit attractors and their potential chaotic environments. When the experiment was repeated with 5 - ∞ bodies and 5 - ∞ attractors, no methods were sufficient to eliminate extraneous forces and chaos was more or less guaranteed. The implications are that managers have to be prepared to embrace chaos rather than eschew the possibility.

Primary to the NDST are the familiar mathematical modeling procedures of strange attractors, chaos, quantum theory, fractals, catastrophe and agent moderation (Guastello, 2006). One example is in Guastello (2006) where interactive dynamics shows up in political, cultural, and organizational science literature. Within simple or multilaterial competitive dynamics, bifurcations and trifurcations of conflicting interests that may lead to interactions become self organizing through the routinization of conflict where that conflict becomes predictable. Another example lies in organizational sciences where Gregersen and Sailer (1993)introduced the notion of chaotic systems in organization. This may well be the seminal point for which chaos and quantum theory makes the leap from the hard sciences into the social sciences, especially in organizational science.

What's noticiblylacking in organizational literature however, is the application of nonlinear dynamic systems, particularly in training for the expectation of reaction to a relevant chaotic international or domestic environment where attention to tasks at hand are apparent.

d) *The Intervention and Treatment for CADD*

The intervention and treatment for CADD can resemble the intervention and treatment for ADHD or ADD. Typical is the co-treatment with methylphenidates as organizational cultural and process stimulants where it is frequently necessary to speed up attention and comprehension and tie that to multi-group discussion processes.

The organizational development processes focus on finding customer level performance indicators and modeling them mathematically to determine which sets of measures are more predictive of necessary action to performance. In the case of promoting innovation and organizational renewal, measures like rate of product introduction, time of innovation to market, % sales from new products, R&D expenditures, costs and efficiency of product development, % involvement in customer value chain, % of development from joint ventures, % customized development for focused customers, degree of product scope, bundling product groups, generating and measuring variations in switching costs, and competitor cost to imitate. It would seem that modeling variances in measures to a performance or effectiveness measure should yield the two or three best measures, and therefore increase overall performance through the processes of getting, speeding and acting upon attention processes.

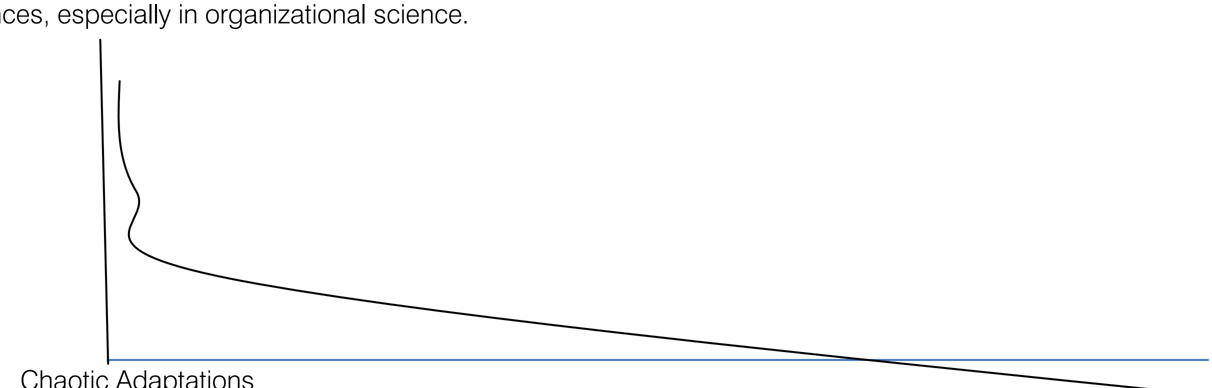

Figure 6 : Chaotic Hysteresis

In organizations, chaos can be seen in the economic environment, but also on a more micro scale of changing abilities to add or vary necessary volume, manage costs, differentiating products or services, position the firm into the industrial position of fit, and deploying learned knowledge. This chaos has three distinctive features. The first is a non-repeating sequence in which the random flux over time looks like wildly random linearity. Every iteration is different and the degree of effectiveness in understanding, use of knowledge, breaking concepts to meaningful chunks, putting things together and making judgments about the reliabiltiy and validity of data. In each case, delivery, rapport, knowledge transfer and course goal attainment varies. In the organizational sciences, we would call that chaotic system in Figure 1 "out of control" and thus needing linear upper and lower control limits of no larger than $1(\sigma(\mu))$. The first example

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would be non-repeating sequences while the second would be a situation of boundedness where the variables under observation are control limited imposed through through rapidly changing standard deviations of $1(\sigma(\mu))$.

Ideally, managers are trained to recognize the rapidly changing environment, adapt, recombine assets, and move back to a state of normalcy. This is a rapid adaptivity activity if that state is chatic. Another type of organization is the one that adapts to the same problem more methodicallyand has the capacity to come back to normalcy, operations within statistical control. Movement within the ranges is unpredictable while movement within the second is limited as being slow to change and adapt, in fact about 5x less adaptable on a time scale.

The third feature is sensitivity to initialconditions. While points of contact start close, with the introductions and assessment and venturing processes early, those processes can suffer entropic decay as the partnerships progress. Taken to a longer time series events with financial and performance variables measured frequently over time (perhaps 52x per year, 5 years) strategic performance iteration becomes a computational technique of starting with a number of experiences both positive and negative and a very large η because chaos mapping requires very large amounts of data iterating through a simple equation.

The results for the magnitude of conflictbetween organizations has an expected value where $R^2 = .8$. The Lyapunov exponent shows strongly positive signifying a trend toward vicious and high velocity environments with then a repositioning toward relative stability.

Suggestions and Research Directions

All of these structures need further research in the social sciences and administrative disciplines where lesson and solutions are taught in a cause – effect linearity. Chaotic structures arise in managerial and corporate competition, especially in the tech environments. In these industries, even Tuckman (1965) would predict a stage of storming and norming to productive behavior. These may come from various strange attractors within both the environment and the corporation. The interest is whether it is better to let the chaotic tendency arise or to intervene with rules and specific measures or let the chaos go with occasoinal continuous correction. Within the best practices literature, there is a general exortation to plan,organize, lead and control performance. It implies a linearity so there is no motion that is out of control and where maximal productivity should naturally occur. Within the chaos theory literature the case is made that the naturally occurring strange attractor creates compound isolations and chaos. While the chaotic system may predict natural trepidation, the Lyapunov, Richardson and Meyers-Kress models would indicate that productivity comes after a period of disorganization followed by self organizational system. Strange attractors create bifurcations, and bifurcations initially create conflict followed by a following period of reorganization and conflictual dynamics. The interesting question is whether there is anything the manager can do to emerge with a self organized system of productivity more quickly. This is absolutely an area for more exploration.

Let us explore a few lessons from the material. For each one of these can provide an independent research direction for the interested writer. The first lesson is to embrace the inner chaos of organizational activity. Knowing there are generally self organizing systems, it is important to realize that granular and financial variation can be the mechanism of performance improvement, the leading indication of chaotic variation can speed correction by months.

The second lesson is there are qualitatively and quantitatively strange attractional events which predict placing organizational variance in context. A strange attractor can be an external event like changing scale, market concentration, location, productivity, size of customer market, customer revenue, acquisition cost, customer investments in relationships, complementor relationships, ROI, risk volatility investment base and cashflows can all serve as the red herrings of strange attractors. The third lesson is to be patient, according to the chaos and quantum literature, systems do organize. How they organize in organizational performance and the span of time it takes will vary under which the conditions and material are clarified. Fourth, and finally, while there is variance in activity, there will also be variance in professional understanding as well creating a strange attractor of its own.

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