

# Insights from Science into Business and Economics: Roadmap to a Fiasco Prevention Theory

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**Abstract** The purpose of this initial work is to explore insights from science into business and economics for a road map to a prevention theory on corporate fiasco, market turmoil and economic crisis. First, we use as scope the natural continuum, which encompasses particles, protoplasm, cell, organism (e.g. *human*), community (*institution*), ecosystem (*market*), biosphere (*economy*) and transcendental systems. This scope would guarantee a solution to any problem within it. Second, the primary focus is on the human component since human is the most intelligent of all organisms. Human has the highest ability to think and make decisions driving institution, market and economy (psychology). Third, as part of the natural continuum, the four components in *italic* would obey the laws of nature, as do the other components. These laws range from Newton gravitational laws to Einstein's relativity. While institution, market and economics can be considered as physical mass, human decisions can be viewed as force moving them from one situation to the next. Decisions can also energize them (physics). Fourth, insights from one known component into another can be drawn by analogy such as a disease in humans is analogous to a fiasco in institutions in terms of hidden signs and symptoms (biology). Fifth, one component is the extension of the lower component, e.g. market is an extension of institution, allowing homeomorphism to be identified (topology). Finally, decisions can be emotion-driven. Thus, insights from neurological and psychological processes in human brain and mind into business decisions can help understand them (neuroeconomics).

**Keywords** Natural Continuum, Laws of Nature, Decision Making, Business Operations and Management, Economics, Neuroeconomics, Fiasco Prevention

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## 1. Introduction

### 1.1. Motivation

Dozens of corporate fiascos leading to bankruptcy have happened during the last two decades [1], [2]. There have been investigations on what happened and why they happened. They resulted in congressional hearings [3], [4], reports [5], [6], lessons learned [7], [8], [9], [10], [11]. New regulations [12] and reforms were proposed in executive directorship, accounting practice, responsibility, accountability and authority (RAA) and the like [13]. But corporate fiascos still occurred [14]. The bankruptcy of Lehman Brothers in 2008 [15] was unprecedented. It not only shook up the finance world, it created an economy crisis [16].

We are motivated to explore insights from science into business decisions, business management and operations, market and economics behavior for fiasco prevention. Since humans create institutions, business and economics, and since science such as biology, physics, psychology, mathematics etc. are discovered and formulated by humans themselves, the links must be there.

### 1.2. Issues Drawn from Past Corporate Fiascos

We examine several important and critical cases of past fiascos for identifying major issues. Among them were Barings bankruptcy in 1995, Enron in 2002 and Lehman Brothers in 2008. All three cases were unbelievable. Barings Bank went down due to the work of one man: Nicholas Leeson [17]. Enron Corporation collapsed due to a group of executives: Andrew Fastow, his boss Jeff Skilling and his supporters [5]. Lehman Brothers filed for bankruptcy due primarily to CEO Richard Fuld [15]. It was the worst case of all since it initiated the financial crisis in 2008 [16].

All three cases involved fraudulent activities. Leeson of Barings, made believe that the bank's business was prosperous while losses have been concealed in balance sheets. Leeson used the error account 88888 and a fictitious client account. Both Fastow of Enron and Fuld of Lehman Brothers) faked losses and profits in their company's quarterly financial statements. Fastow used special purpose entities (SPEs) in the thousands to keep losses reported elsewhere. Fuld used Repo 105 and lied about a hedge

account with Bank of America.

We identify four major issues: (1) hidden symptoms, (2) aberrant corporate decision, (3) weak corporate governance, and (4) inattentive regulators and their questionable interventions.

### 1.2.1. Hidden signs and symptoms

Many outcomes of wrongdoings are detectable and/or predictable, but sometimes ignored or forgiven. Some are unknown or unpredictable. Yet others are hidden or covered up. Examples are Leeson's use of error account to hide the loss of hundreds of millions or Andrew Fastow of Enron's violation of the 3% independent investment requirements in SPE. The signs and symptoms of those faulty outcomes are always there however. Whether or not it catches the attention of the responsible parties is another issue. Examples are (1) Leeson's dual role of both front office (trading) and back office (settlement) of Barings Futures Singapore (BFS) and (2) and Arthur Anderson dual role of both auditor and consultant.

Commonly the symptoms are known or aware of by some other humans, with some form of warning, but either warning is ignored or no actions are taken. James Bax of Barings has warned Barings top management on Leeson's dual role. Arthur Anderson as accounting auditing and consulting arm to Enron was aware of Fastow's violation. This suggests the need to pay particular attention to the early detection and transparency of symptoms of faulty event to all responsible parties.

### 1.2.2. Aberrant decisions

In the context of events or outcomes and decisions regarding them which led to fiascos, we observe that some decisions are rational such as Barings' decision to enter the derivative market between Osaka and Singapore. Some are problematic, such as Nicholas Leeson of Barings' decision to hide the first £20K loss in his error account 88888 [18]. Some decisions are driven by greed, e.g. Andrew Fastow of Enron's decision [19] on the use of SPEs; some by high risks, e.g. Leeson's doubling trading scheme on Nikkei 225 index after the January Kobe earthquake in Japan [18]. Many are driven by rewards or profits, e.g. Jeff Skilling's mark-to-market in Enron's gas bank scheme [19].

### 1.2.3. Weak governance

Fiasco does not come alone although it abruptly occurs. It is quite often resulted from a sequence or series of the symptom-decision complexes in space-time which escape corporate governance for any reason. Institutions are driven by humans (executives, leadership team and/or others). The human decisions to enter a market of interest (i.e. sellers and buyers) would influence the market somewhat and somehow. They have a lot to do with the way decision makers perceive the environment in which they exist in terms of risks and/or rewards/losses. The higher are the risks, the better the rewards or the worse the losses. To control prices in their

own market [20], the institutions can create shortage (Enron faked the electricity shortage in California) or surplus [9]. They can exercise expansion (Lehman Brothers bought BNC to expand their subprime lending activities) or downfall [15]. They can manipulate profit or loss (Leeson of Barings Futures Singapore played doubling or Martingale scheme in derivatives).

The market does not have to be just the above. It can be capital market, credit market, money, primary, secondary, or anything humans can think of to create them. It can be any product, service, or information. The behavior of the latter would affect other related markets.

### 1.2.4. Inattentive regulators and questionable intervention

Besides the players of the market, there are also the regulators. They might not pay enough attention early enough. This fact has been observed in all three cases.

When the market experiences turmoil, it might lead to financial or economic crisis. The regulators might laissez-faire following Friedrich Hayek, as in the cases of Barings Bank and Enron. They might interfere following John Keynes, as in the case of Lehman Brothers and other collapses with President Bush's stimulus package, Fed bail-outs, lower interest rates, etc. in the attempt to alter or redirect the economy. Interestingly, Ben S. Bernanke, the former Fed chairman and Henry M. Paulson, the former Treasury Secretary decided not to bail out Lehman Brothers.

## 2. Insights from Science into Business & Economics

In this section, we look at the natural continuum in which humans live for insights from science (biology, physics, psychology, neuroscience, etc., the disciplines which are discovered, explained and formulated by humans) for insights into institutions, market and economics, which in turn are human creations.

### 2.1. Insights from the Natural Continuum and System Science into Scoping Fiasco Problem and Solution

First, the four components, human, institution, market and economy are parts of the natural continuum from particles (lowest level), protoplasm, cell, organism (e.g. human), community (e.g. institution), ecosystem (e.g. market), biosphere (e.g. economy) and transcendental systems (highest level) as partially sketched in von Bertalanffy-Boulding General Systems Theory [21], [22]. As such, if we consider the entire natural continuum, the problem will certainly be within this scope, as well as the solution, due to closure property of the natural continuum.

There are some interesting observations (sketched as dotted box in Figure 1 and as bold boxes in Figure 2, bottom box).

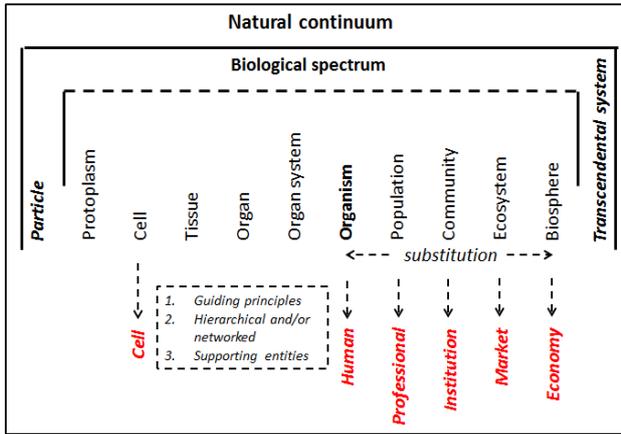


Figure 1. Natural continuum and biological spectrum

At the cell level, three guiding principles govern the cell structure, functionality and behavior: (1) “milieu interieur” or internal environment which say that all cells are within an interstitial fluid (or plasma) of the human body according to Claude Bernard [23], (2) cell dynamics are under cybernetics which exercises the control over cells according to Norbert Wiener [24], and (3) all cell metabolism is to maintain homeostasis of the human body according to Walter Cannon [25].

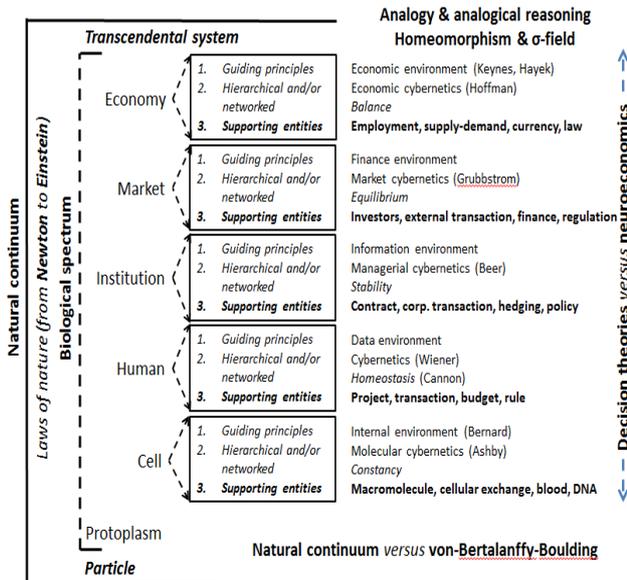


Figure 2. Guiding principle, organization and operations across components

By analogy we can identify the similar guidance principles in higher level components (Figure 2). The three guiding principles in each component and all component levels from cell to (biosphere) exhibit a systemic nature. These include the cells in the interstitial fluid & plasma, the humans in its data environment, the institution in its information environment, the market in its financial environment, and the economy in its monetary environment. They govern all different structural and functional organizations whether the latter are hierarchical, networked or any combination thereof

[26], [27], [28].

Also by analogy, the three guiding principles at cell component can be extended to the higher components (top boxes in Figure 2). Humans in an institution live in a data environment analogous to the milieu interieur of cells. They are under control of managerial cybernetics according to Stafford Beer [29] analogous to cybernetics of cells developed by Ross Ashby [30]. This is to maintain stability of the institution, analogous to homeostasis in the human.

Similarly, the institutions are within a sea of information environment, under the control of market cybernetics according to Robert Grubbstrom [31] while attempting to maintain market equilibrium, analogous to institution stability and human homeostasis. Finally, the economic environment within it all markets interact is controlled by the economic cybernetics [32] to maintain economic balance as shown in Figure 2.

We also can equate operational entities in the cell component such as macromolecules as employee functions in the human component, business functions in institutions, investors in the market and employment in the economy. By the same token, cellular exchange can be considered analogous to transactions, corporate transactions (such as SPEs), business deals (or external transactions defined by R. Coarse [33] or supply-demand in economy. This goes for the equivalence of blood and DNA (cell level), budget and policy (human level), hedging and regulation (institution level), finance and law (market level) and capital/credit and pricing in economy.

The natural continuum and system science provide a rich analogy between components and their structural, functional and behavioral organizations and operation such that analogical reasoning from one known component can be explored for insights into another. We admit that some analogues might be weak but as we go further, properly scoped analogous entities can be identified and adjusted via the analogical reasoning.

## 2.2. Insights from Biology’s Cancer and Disease into Business Fiasco Signs and Symptoms

Although in a human body where homeostasis is the main objective, human will experience sickness. Similarly, while attempting to be stable, an institution can get sick. One analogous idea coming out of the cell-human analogy is the idea of disease, one of which is cancer.

A cell in a human body can be abnormal. Starting off with an abnormal division (one cell rather than two cells), cancerous cells grow uncontrollably. It begins to invade nearby tissues within the interstitial fluid between cells. It later proliferates to other organs via the circulation system and the lymphatic system. Most of the times, when symptoms are detected, the cancer is already in later phases. It would be extremely difficult to recover from. Although there are survival cases, more likely the humans with cancer will face death [34], [35].

When humans in an institution are equated to cells in a

human body, a few “abnormal” humans can influence others in their closest professional circle to invade some organizational units. They can further expand to others in the institution. If the symptoms of their influence are not detected in time, it might create some fiasco within the institution which can lead to collapse.

Recall that cancer signs and symptoms like any signs or symptoms of any disease in a human body are under the control of the autonomic nervous system. They always there but not reported to the human brain at the conscious level [35]. Based on this insight, we would develop a management by exceptions application system in the institution to make sure all symptoms are detected, validated, made transparent, and evaluated with an assigned criticality value.

### 2.3. Insights from Psychology’s Kelly’s Theory of Personality into Corporate Decisions

George Kelly [36] was the author of Theory of Personality: Psychology of Personal Construct (PCT) for clinical environment. He looked at patients with psychological disorders from the basis of dipole concept. A human mind is described as a conglomerate of mental properties called constructs. Each construct has two extremes: good versus bad, peaceful versus arrogant, friendly versus bullying, etc.

To explore the patient’s mind, Kelly’s idea is to exercise a carefully designed face-to-face interview with the patient to determine the set of constructs describing the patient’s thoughts and thought process with regard to some objective. This elicitation would result in a repertory grid (RG). The cells in the grid would be marked with a measure associated with selected elements, one triad (3 elements) at a time, from very similar to very different [37], [38], [39].

The technique has been extended to other disciplines [40], [41], [42], [43]. It was applied to decisions as described in Nguyen [44]. Our intent is to similarly establish a criticality value to severe symptoms and/or aberrant decisions.

### 2.4. Insight from Decision Science and Neuroeconomics into Qualification and Quantification of Decision Impact

Traditional and modern decision theory is well presented in many texts, e.g. Jim Berger [45] or D. W. North [46] and many others. A utility function associates values to choices (or decision alternatives) and outcomes. Von Neumann & Morgenstern [47] included the element of uncertainty in their expected utility (EU) theory. Kahneman & Tversky with their prospect theory [48] was next as an alternative to EU theory. Prospect theory looks at values assigned to gains or losses and decision weights rather than probabilities. Prospect theory thus extended the limitations of expected utility approach.

Recently, researchers attempted a new approach to understanding decisions which is termed as decision neuroscience or neuroeconomics [49], [50]. Many decisions are emotion-driven as we can observe ourselves. This is

confirmed by Antonio Damasio in his famous book “Descartes’s Error” [51]. The physical reason is due to the structure of the human brain. Human has three brains in one, called the triune by Paul MacLean [52]: the reptilian brain (fight or flight), the mammalian brain (emotion) and the neocortex (logical thinking) as performed by the prefrontal neocortex area and the precuneus in the superior parietal area in the brain.

At the neurophysiological level, according to Daeyal Lee [53], decision making involves multiple brain areas through coordination. To understand the lower level brain disorders and their effects, Lee took a top-down view to explore how prospect theory and reinforcement learning theory related to low-level brain decisions. Lee reviewed various functions used in decision making under risk in an economic context, such as utility function for maximizing expected values. Others include value function, discount function and forgetting function for improved inter-temporal choices involving delays of rewards. Lee examined the shapes of the functions to determine the strength of risk, averse or seeking, in the context of prospect theory.

Consequently, Lee offered an extensive review of decision making and the linkage between neurological level and psychological level, together called *cognitive neuroscience*. Any deviation from normal behavior would lead to different types of neurological and psychiatric disorders. This line of thoughts has been discussed and researched at the Kavli Foundation [54].

In 2011, a new line of thought by Kahneman called Thinking Fast or Slow [55]. It consists of System I which is limbic-driven (think fast) and System II which is neocortex-driven (think slow). It further shows the psychological influence, linking economics to psychology, together called *behavioral economics*. The new trend is to look at neuroscience, psychology, and economics as an integrated neuroeconomics [56]. The findings in neuroeconomics, together with Kelly’s RG would shed insights into our attempt to understanding decisions.

### 2.5. Insight from Laws of Nature into Defining Principles and Policy

As components of the natural continuum, the human, institution, market and economy would obey the laws of nature. These laws range from, but not limited to, Newton gravitational laws (force and gravitation), Coulomb (charge), Faraday (induction), Maxwell (electromagnetism), Planck (Quantum) and Einstein’s relativity.

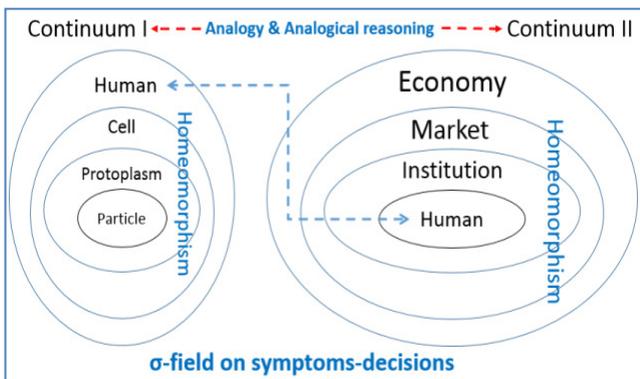
In fact, a decision is much more than just a fix to a particular issue. It can be a course of action or strategy, short-term or long-term, moving an institution for a point A to a point B. Decision might act like a force. It can open opportunities to many institutions, such as President Clinton’s Banking Act after the merger of Citi Corp and Travelers Insurance. It may generate hope to low income homebuyers such as President Bush’s American Dream Down Payment Act. The last two examples energize

people’s interest in terms of risks and rewards, much like electric and magnetic fields.

Large institutions like Lehman Brothers and other investment banks are like the sun around it other institutions pivot, analogous to the solar system where a gravitational space-time curvature. It suggests an analogous economic space-time curvature. The collapse of those huge institutions or conglomerates will affect the remaining pivoting institutions. Anything happens to them will also affect the other components. We reexamine these laws for identification of appropriate and applicable principles and policy.

**2.6. Insights from Homeomorphism between Components into Defining Process**

On the one hand, we would exploit analogy concepts and applicable analogical reasoning between different component levels as shown in Figure 2, primarily between cell-human and human-institution from the base analogue. On the other hand, within each component from top (general) to bottom (specific), we can identify at least three layers. The *top-layer guiding principles* involve homeostasis (goals), cybernetics (control) and “milieu exterieur” (environment) and their analogous principles in other components. The mid-layer *organizations* in terms of structure, functionality and behavior exist within each component. They are different only in terms of how they address the environment, at each component level. The bottom-layer *supporting entities* in the operations of each component also can be defined.



**Figure 3.** Insights into homeomorphism

When macromolecules in cell-human component are equated to projects in human-institution component, then to contracts (business deals) in institution-market component, to investors in market-economy component, and finally to labor in economy and beyond, the analogy broadens as we go up component level since the next higher level is more than the sum of its parts, by virtue of abstraction. There is the element of emergence.

Nevertheless, there is the possibility which one could investigate fully, i.e. the homeomorphism (*topological isomorphism*) between components in the natural continuum,

different than the isomorphism promoted by von Bertalanffy [21]. The homeomorphisms between components are based on known processes in a known lower-level component such as cell-human, human-institution, for application to institution-market or market-economy component for the derivation of topological equivalent in others. The idea is that further detailed behavior of one lower component can lead to those in the higher level component by virtue of topological isomorphism between them. As shown in Figure 4, homeomorphism would exist in Continuum I because the higher components can be considered as stretch of lower component (human, cell, protoplasm, particle). Similarly homeomorphism would also exist in Continuum II as economy, market, institution are different stretches of the collection of humans. We would identify topological invariants (e.g. two employees in the same organization unit of the institution remain the same in the institution, market or economic stretch) for defining homeomorphism.

**2.7. Insights from σ-field and algebraic topology into solution formulation**

Some mathematical tools are readily available for applications to business, which are yet fully exploited. Two such tools are σ-field in abstract algebra [57] and algebraic topology [58]. We would look into (1) σ-field on the set of symptoms-decisions as a measure theory to yield sequence or series of decision impact and (2) algebraic topology to find homeomorphism among components of the natural continuum.

With the numerical measures  $\mu$ , assigned or calculated, associated to the symptom-decision complex, as hinted previously, the  $\sigma$ -field on the *symptom-decision* complex set  $D$  emerges as  $\{D, \mathbf{D}, \mu\}$  where  $\mathbf{D}$  is the power set of  $D$ .

**3. A Roadmap to a Fiasco Prevention Theory**

A fiasco most likely starts with a decision by someone somewhere at some instant. In the case of Barings bank, the decision was to make Leeson the general manager of Barings Futures Singapore. In the case of Enron was Ken Lay’s decision to appoint Jeff Skilling as CEO to carry out his Mark-to-Market scheme. In Lehman, the decision was to enter the subprime lending market. It was all good starting points.

However these “characters” with their “abnormal” and questionable mind started to expose wrong behavior. Symptoms of bad outcomes started to occur. We can formulate a fiasco  $F$  as a sequence (or series) of symptoms  $S$  and decisions  $D$ . A particular decision  $D_i$  will lead to some outcome considered as bad symptom  $S_i$ , which in turn requires another decision  $D_{i+1}$  which leads to another bad symptom  $S_{i+1}$ . The sequence is defined as

$$\text{Sequence } F = \{D_i \cup S_i\} \text{ or Series } F = \sum \{D_i \cup S_i\}.$$

The union indicates either a decision causing symptoms of a bad event, or a symptom requiring a decision, or both.

To characterize the  $D_i$  and  $S_i$  we use the Repertory technique from George Kelly added with consideration on neuroeconomics to arrive at a numerical measure  $\mu$  for individual ( $D_i \cup S_i$ ). An impact is defined as the numerical difference between  $(D_{i+1} \cup S_{i+1})$  and  $(D_i \cup S_i)$  which is termed as  $e_i$ . The  $e_i$  can be any value and can be either positive, negative or zero. To keep  $e_i$  within the interval  $[-1, +1]$ , we would use the conversion  $f(e_i) = e_i / (1 + |e_i|)$  to normalize.

To simplify, we would use the set  $e_i = \{-1, -1/2, 0, 1/2, 1\}$  as follows. If the symptom-decision complex value is qualitative (or categorical), its value can be (1) no impact  $e_d = 0$ , (2) highly negative impact  $e_d = -1$ , (3) negatively impact with  $e_d = -1/2$ , (4) highly positive impact  $e_d = 1$ , or (5) positively impact  $e_d = 1/2$ . Thus, the sequence will be a collection of values from the set of  $\{-1, -1/2, 0, 1/2, 1\}$ . The elements of the sequence can be in any order, therefore the sequence or the series (i.e. the sum of sequence) can either convert or diverge.

Some impact can be filtered out and/or combined according to Dempster-Shafer's combination rule [59] in their theory of evidence. In our context, evidence can be either signs and symptoms or decisions, or both, ( $D_i \cup S_i$ ).

It turns out that we would evaluate the sequence or series of normalized  $e_i$  such that if the sequence or series converge, we would reach a local equilibrium. If it diverges, then fiasco will occur. In this case, we can try to find a sub-sequence to insert into the current sequence and bring it to converge.

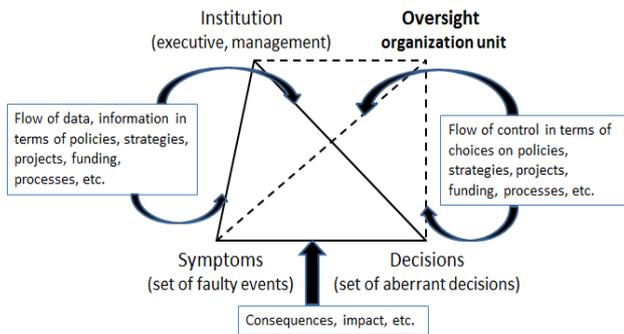


Figure 4. Conceptual model

## 4. Concluding Remarks

From the previous discussion on symptoms and decisions, we can structure the problems into three interrelated domains. First, all faulty signs and symptoms must be detected, validated, evaluated and made transparent, and acted upon. Second, decisions must be elicited for understanding the root causes if aberrant for proper intervention. Of course the people involved (institution decision makers) do not want anyone to know. So, third, there must be a control to be exercised by an organization unit parallel to the institution to

monitor impact and raise concerns if any. A conceptual model is sketched in Figure 4.

With three such domains of interest: symptoms, decisions, and control, we would formulate a possible scheme as exemplified in the following.

With the different insights we have gained from various scientific disciplines into business operations and business management, and economics as described in the previous section, we can detail the conceptual model for corporate fiasco prevention as follows.

1. *Sign and symptoms.* On the symptoms set, we would want to build an integrated management by exceptions (MBE) system in the institution encompassing people, policy, process, products, and practices. The MBE would reveal all possible symptoms across the institution. The symptoms will be evaluated as warning or severe criticality. The MBE might be integrated with current ERP (enterprise resource planning), SCM (supply chain management), CRM (customer relationship management) and/or any other enterprise applications in support of the institution operations. Initially, the supporting entities listed Figure 2 of each component (institution, market and economy) are of key concern. Data acquisition is coupled with data analysis to produce scheduled or custom reports for the reporting of symptoms to be transparent across all responsible parties. From cancer analogy, we learn that the symptoms are always there. They are hidden below the conscious level so the idea is to raise awareness of hidden symptoms for proper attention.
2. *Decisions.* The set of human decisions regarding the symptoms is crucial. They have to be quantified. Initially, in addition to known quantitative methods, a RG technique can be used for the understanding of each and every decision made and for the determination of its criticality. Understanding of managerial decisions can be added with experimental knowledge gained from decision neuroscience, termed as neuroeconomics. Also, crucial is the application of the laws of nature on the decisions for the understanding of their impact to the environment. The evaluation of impact will be quantified and normalized. They are to be computed and evaluated as a sequence and/or series of impacts so that appropriate insertion of subsequence can be exercised to alter the divergence if any.
3. *Control.* The Oversight organization unit must be created by the Board of Directors. This unit exists in parallel with the institution's line of command. It has access to all aspects of the institution. It has the role of check and balance. It can question anyone in the line of command for justification of decisions made.

This paper suggests a collection of concepts drawn from insights from biology, physics, psychology, neuroscience,

decision science, abstract algebra and algebraic topology into business operations and management. They are still the tip of the iceberg. We need to go deeper via analogy and analogical reasoning, as well as further exploit the laws of nature and mathematical tools for detailed specifications of the problem towards a viable solution.

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