Systemic Practice and Action Research, Vol. 18, No. 4, August 2005 (© 2005)
DOI: 10.1007/s11213-005-7170-x

From Cybernetics and VSD to Management and Action

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Received June 18, 2004; revised June 22, 2005

This paper uses Stafford Beer's Viable Systems Diagnosis (VSD) to suggest that the development of a model for actionable theory in organizations would take the form of a three-step process. The first step involves the definition and explanation of an appropriate theory base, the second theory interpretation into a coherent set of action principles and the third contextual action in organizations. We contend that even for a well-informed and widely read manager gleaning the theoretical basis for this process from the recognized Beer trilogy "Brain of the Firm," "The Heart of the Enterprise" and "Diagnosing the System" is difficult to justify in terms of time, understanding, and action. We maintain that a sound set of action principles emanating from Beer's primary work must be considered before tackling the noted trilogy. We use Beer's initial text "Cybernetics and Management" to trace some fundamental operational research and the interdisciplinary tripartite science of cybernetics. We commence our action model process with some introductory thoughts into operational research, cybernetics, VSD, and contextual action. Our first step toward action involves some primary definitions and principles of cybernetic theory and the prospect of controlling overwhelming variety. Our second step provides our set of coherent potential action principles fundamental to cybernetic theory. The paper is written in a journalistic rather than academic style reflecting the need to couch the interpretation of the theory in a language that the well-informed manager may readily translate into third step contextual practice.

KEY WORDS: cybernetics; Viable Systems Diagnosis (VSD); management; action.

1. INTRODUCTION—OPERATIONAL RESEARCH, CYBERNETICS, VSD, AND CONTEXTUAL ACTION

Operational Research (OR) came to prominence through the application of RADAR in 1938. Its further intervention and influence in World War II

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subsequently accelerated the growth of traditional sciences into previously unchartered territories. The new era saw science discussed from a somewhat unconventional interdisciplinary point of view that included the consideration and challenge of feedback and control in organizations. Coinciding with the open systems view of Von Bertalanfy (1968), the new discourse challenged the traditions of linear thinking and questioned how differing interpretations of theory could be translated into manageable action. Weiner (1948) termed this new field of scientific endeavor cybernetics. Beer's (1959, 1966, 1968, 1971, 1974, 1979, 1985) gift to modern management, Viable Systems Diagnosis (VSD) evolved over a 40-year journey and is genuinely based on OR and cybernetic theory. This paper suggests that Beer's work provides the basis for the development of a model for actionable theory in organizations and which would take the form of a three-step process. The first step involves the definition and explanation of an appropriate theory base, the second the interpretation of that theory into a coherent set of potential action principles and the third contextual action in the organization. The paper is based on VSD and involves the first two steps. We have purposely written the paper in a journalistic rather than academic style reflecting the need to couch the interpretation of the theory in a language that the well-informed manager may readily translate into third step contextual practice.

2. A FUNDAMENTAL VIEW—PRIMARY DEFINITIONS AND PRINCIPLES OF CYBERNETIC THEORY

There is a widespread consensus that an appropriate interpretation of the VSD theory base can be gleaned from the Beer trilogy *Brain of the Firm* (1971), *The Heart of the Enterprise* (1979), and *Diagnosing the System* (1985). But from the perspective of well-informed managers, we find this consensus difficult to justify in terms of linking interpretation to action. We believe this disparity involves a lack of consideration of the fundamental theory base on which the trilogy is founded and the subsequent inaccurate managerial interpretations of some key definitions. We contend that for a necessary and sufficient set of actionable principles to emerge from the trilogy or VSD a grasp of the primary theory, espoused in Beer's *Cybernetics and Management* (1959) is essential. We argue that the proper interpretation of the fundamental nature of control and the concept of the organization as a machine emanating from *Cybernetics and Management* are crucial to the modern understanding of this theory and central to the progression of contextual action.

It is significant to note that it is about half a century since Beer's contribution to actionable theory began with the writing of *Cybernetics and Management*. Today cybernetics is more likely to be associated with the virtuality of cyberspace than the Greek *kybernetes* meaning steersman. Funk and Wagnall (1984) define cybernetics as "the science that treats of the principles of control and communication as they

apply both to the operation of complex machines and the functions of organisms." In any reference to Beer's work, the words "control, communication and machine" dominate, with little or no reference to the functions of organisms. Herein lies a fundamental problem to the modern understanding of cybernetics and VSD, even for well-informed managers. In this context, we find that time has not been kind to Beer, nor for that matter to a widespread understanding of the science of cybernetics. We see our reflection of Beer's primary theory as providing for a better interpretation of his initial cybernetic definitions and a solid foundation to our offering of action principles for the well-informed manager.

The germination of cybernetics "as a new science of mixed pedigree and high pretensions: an upstart in the society of science" (Beer, 1959, p. viii) proposed that some fundamental harmony subsisted between control mechanisms and the various different "empirical" sciences. Here, for the first time, academic discourse involved the interdisciplinary merging of established sciences to encourage the amalgamation of knowledge previously specified to individual domains. Cybernetics sought a universal theory of control abstracted from the applied fields, and suitable to all of them. For Beer, this search concerned the intersection of the biological and physical sciences. His biophysical consideration of information flows in organizations commenced with the writing of *Cybernetics and Management*.

Cybernetics and Management is segmented into five parts each commencing with a connective summary. Certainly the interconnectivity and recursive nature of the format aligns to a favorite Beer metaphor—the principle of "a set of Chinese boxes or Russian dolls, wherein each is contained within the next" (Beer, 1979, p. 118). For Beer, the importance of interconnectivity and recursion as fundamental building blocks of the "new" science of cybernetics is discussed in the context of a systems approach throughout *Cybernetics and Management* and of consequence during the evolution of VSD.

His systems approach, fundamental to cybernetics, describes dynamic interactions of the whole. Beer sees the consideration of either wider or alternatively more compact forms relating to the whole visualized according to the concept of (recursive) layers, interactivity between the bits and pieces within each layer, and the interconnectivity of the bits, the pieces, and the layers. Beer presents the *control* of these dynamic interactions, as an attribute of a system. However, according to Beer "this word is not used in the way in which either an office manager or a gambler might use it: it is used as a name for connectiveness" (Beer, 1959, p. 9). This crucial point cannot be overemphasized for those seeking an appropriate interpretation of the fundamentals of cybernetic theory where the use and understanding of the word control is manifestly different from its generally accepted nature in the twenty first century. Beer delineates control as meaning the self-regulation or self-emergence surfacing *from* a system. We believe this understanding must be retained and is pivotal in the consideration of the contextual VSD. We see managers needing to view control from an abstract sense, as equating

to what happens intrinsically, what evolves when they (as part of those systems) decide, react, and adapt to the situations they normally encounter on a daily basis. Cybernetics, defined generally as the scientific study of the nature of control, we believe, needs to be clearly interpreted by managers from this perspective of self-regulation existing within. It must be seen as surfacing from whole organizational systems. To interpret it in the narrow sense of the giving of orders and directions to various parts of the organization is to lose this important sense. From the readings of Beer's initial works, we see the four elements of a systems approach, interconnectivity, recursive layers, and control as self-regulation, as crystallizing into some potential action principles for today's managers. An arbitrary categorization of systems therefore completed the primary focus and background to Beer's primary cybernetic thoughts. Beer categorized systems according to the matrix shown in Table I.

Under this categorization, control referred to the management of individual companies viewed as exceedingly complex, probabilistic systems. In the sense that we are discussing medium to large companies rather than the local sandwich shop, modern companies can still be adequately categorized as probabilistic rather than deterministic as they are exceedingly complex rather than either complex or simple from a logical sense. We see control in its emergent organizational sense as manifest when a desired output is achieved by self-regulation in that both input and output calm down and stabilize so that the operation exists in a steady equilibrium state. This concept of a steady and stable state does not preclude or diminish the importance of quite normal occurrences such as time lags, or the usual range of things that do go wrong. In this sense, the emergent control system results from systems moving out of control. It merely represents our interpretation of an implicit

Table I. Categorization of Systems According to Beer

	Probabilistic: No precise detailed prediction can be given—the system is not predetermined	Deterministic: The parts interact in a perfectly predictable way—no room for doubt
Simple—simple but dynamic	Penny tossing Statistical quality control	Window catch Billiards Machine shop layout
Complex—not simple richly interconnected, complex but describable	Stockholding Conditioned reflexes Industrial profitability	Digital computer Planetary system Automation
Exceedingly complex—so complex cannot be described in a precise and detailed fashion	The economy The Brain The Company	Nil

Source: Adapted from Beer's *Cybernetics and Management* (1959, p. 18).

control system where the normal variable input and output factors are kept under control by feedback systems inherent in the system. In the probabilistic sense, we see modern management intervening to regulate systems with the confidence that things can be made to go right, whereas the overall Beer aim is to strive for a "higher" self-regulation system that cannot go wrong. How we are guided to strive for the Beer "faultless company control system" is the genesis of *Cybernetics and Management* and of consequence Beer's other works and VSD.

For Beer, this search naturally involved the interdisciplinary nature of cybernetics. He pondered over naturally occurring and seemingly intrinsic control mechanisms, specifically from a biological sense. He summarized these control mechanisms as homeostats (control devices for maintaining variables between preferred limits) and thus described the ideal company control system as "a homeostatic machine for regulating itself" (Beer, 1959, p. 22). Today, this "homeostatic machine" description generates a second crucial point to an appropriate interpretation of cybernetic theory. The portrayal of the company as a homeostatic machine needs to be considered according to the original Beer appraisal—a machine as a purposive system, albeit exceedingly complex and probabilistic.

> now the kind of machine we have been examining is an *organism*, having its own unity and purpose: thus the metaphor 'machine' is appropriate *for mechanical, or animal, or social or formal descriptions*. It is this concept, in all its variety, which underlies the search for patterns in most good OR: it might be called the cybernetic model (Beer, 1959, p. 39) [Our emphasis]

As an example, Beer cited a horse and rider moving as the one purposive system, a machine. The whole system is deemed as self-regulating with both man and horse responding to feedback and attaining a desired state of action. An up-to-date example is the daily interaction of the PC and the worker acting as one purposive system. Unfortunately, the modern meaning for machine is more likely to relate to a mechanistic or mechanical function. Such machines sit in the simple probabilistic or simple deterministic categorization of systems and are not part of the cybernetic area under consideration. The point being that the latter interpretation can create the impression of a distinct separation between man and the many (simple) machines operating within companies. Beer never intended this segregation. He viewed the company as a self-regulating homeostatic machine to be considered as a whole. For Beer, the issue was to "discuss the intersection of men and machines in a way which suggests that they form an indivisible synthetic system of a higher type" (Beer, 1959, p. 24). It is our belief that we have learned to accept the concept of control/feedback in inanimate machinery. There is some difficulty in the idea of conceptualizing social, economic, and managerial control systems as an integration of biological, organizational, and machine systems. This is what we miss with the wrong reading of the Beer "machine" philosophy. Any search for "a homeostatic machine for regulating itself" must recognize that

such a control system encompasses a cohesive collection of items, people, and information forming some purposive system. If we are to call these systems, our companies, machines in the inclusive Beer sense, then it may be better to refer to the numerous "simple machines" within them as "applications" to avoid confusion.

We see viable companies acting as Beer machines—they exhibit exceedingly complex, probabilistic, homeostatic character. They continuously deal with and adapt to events both expected and unexpected. Over time, adaptation to such events enables managers to recognize some consistent patterns. In *Cybernetics and Management,* Beer referred to these types of patterns as stochastic. It is important that we understand what Beer meant by the stochastic process. We believe that today the word stochastic is more appropriate than probabilistic in describing company behavior. One example of stochastic behavior is the process of coin tossing. For any short run of spins, the frequency of either head or tail is unknown and not predictable. But we know that given enough spins the total number of either heads or tails will be equal. Pattern emerges from randomness. Trains working in public transport are another example. Trains get to destinations with some degree of punctually (pattern). But there is no way of predicting the actual surges in speed required to meet that punctuality due to variables such as the weather encountered or the behavior of humans entering or exiting the system. If we consider companies from a segregated point of view, they do exhibit stochastic behavior within their immediate environment. At any point of time, when managers act, specific variables do produce largely unscripted behavior. But in general, company behavior, although probabilistic (*no precise detailed prediction can be given—the system is not predetermined*), does exhibit continuity and display pattern; the company behavior process is stochastic.

This being the case, Beer suggested that some sort of (Beer) machine must have been producing this continuity and pattern. Using primary cybernetic theory, managers can now begin to envisage their companies as homeostatic machines, ones that in the long, rather than short run self-regulate and produce stochastic behavior seemingly from some sort of internal engine room [our, not Beer expression]. In Beer terminology this is "the secondary machine: the machine that lives inside the first like a parasite; the machine for slowing down and stopping the plant" (Beer, 1959, p. 40). We believe Beer is saying that if managers apply primary cybernetic thinking, they may be able to investigate and uncover the engine room/parasite components that produce the stochastic, homeostatic behavior evident in viable companies. In the search for this "faultless company control system," Beer found it necessary to discuss open and closed systems. He pointed out that, strictly speaking, there could be no such thing as a closed system. But for this discussion, the significance of a class of machines not to be considered as either completely open or completely closed, but as quite simply having inputs or outputs needed to be recognized. It is our opinion that the fluid bifurcation of "open and closed" systems within a systems approach is central to cybernetic

thinking. From our experience, most managers are concerned with a microcosmic, "closed system" approach to management. Beer described the concept of a closed system as

> operating a single valued transformation for each of the possible states of its inputs. It does not work on the input and do anything with it other than transform that variable into another form of information [our emphasis] (Beer, 1959, p. 41)

Seeking congruence with this intrinsic engine room/parasite, Beer introduced the concept of isomorphic (having a similar form) mapping. He suggested that managers should map the information flows emanating from any level of the company operation. We read Beer's isomorphic mapping as the delineation of discernable information flows that emerge over time from the machine using the principles or input/output and feedback as the template for the map. To understand Beer's concept of isomorphic mapping, we suggest that managers should forget what they do know about management and assume the role of some independent "rookie spy" perched in a helicopter position atop a totally unknown (company) machine. Over some extended period of time, the purpose of the spy is to go about recording observations and transferring them into an isomorphic representation of this machine's operation, using input/output systems. Initially, one assumes the spy would observe an exceedingly complex, almost frenzied, operation. We describe a frenzied operation as a situation where the variety exposed by the system is initially too much for the brain to handle. This view is consistent with the Beer philosophy:

> remember that no brain and no computer does or ever can exist that is large enough to accept all facts and to permute them against each other as a means of finding the best set of relationships. (Beer, 1959, p. 230)

But fairly quickly, the brain of the spy would react to this frenzied variety. While the spy's brain would not immediately be able to permute all relationships, it would gradually perceive some comprehendible order. Observations would eventually reveal some pattern and relationships would emerge. Some "input" pattern would become evident to the spy as the things we know as people and resources would be recorded with some regularity as inputs and outputs. The spy would observe apparent boundaries materializing around a "closed" internal operation. Although the spy cannot see what actually happens inside the company walls, it is evident that something happens as goods and services emerge regularity as the machine "output." The spy would detect relative consistencies with these inputs and outputs. Looking deeper into the layers of the company, the spy would eventually discover a wealth of information flow from what we know as departmentalized company data, facts, and relationships (financial, human resources, strategy, technology, marketing, etc.). Over time, the "spy" isomorphic mapping would reveal how information flows diminish the inherent complexity of the operation. The

information flows dissipate the variety emerging from the machine. For Beer, the isomorphic mapping of information flows revealed insight into the engine room/parasite components of the stochastic, purposive machine. We agree that the mapping of information flows is essential for managers searching for a better understanding of their company-produced behaviors. We support Beer's contention that the discovery and mapping of information flows has the capacity to reduce frenzied variety to a manageable state.

3. CONTROLLING OVERWHELMING VARIETY

Beer says that the variety in any system is dependent on the number of distinct elements in the system. In the company machine, this number is realistically immeasurable, implying overwhelming, if not incomprehensible, variety. But in rudimentary terms, we have shown in our "rookie spy" example that when the machine can be seen through the lens of isomorphic mapping with input/output and feedback systems, a degree of order can be observed. It also becomes clear how information reduces the overwhelming nature of that variety inherent in companies. As a vital precursor to managers considering contextual VSD, we introduce the concept of the *variety dial*. Control emerging from the company engine room can be likened to the metaphor of a sound system volume control. In the Beer sense, the variety dial is a feedback system that uses information to extinguish variety, in this case, too much or too little volume and becomes a self-regulating system. (This example of a human using a dial is a good example of a Beer "machine)." Company systems possess many such self-generating "variety dials" where management is able to turn up (ameliorate) or turn down (attenuate) informational "volume" in the pursuit of company homeostasis. The question then becomes can managers do this for exceedingly complex, stochastic, homeostatic systems? In keeping with the interdisciplinary aspect of cybernetics, Beer sought recursive epistemological assistance from teleology, psychology, logic, ontology, and mathematics and it is at this point in *Cybernetics and Management* that Beer introduced the principle of the Black Box.

It is our opinion that the prospect of using VSD for contextual action in the company is unlikely to be successful without an understanding of theory behind the Black Box. Beer describes the principle surrounding the Black Box as a categorical, inaccessible system, which must be adopted to provide for the process of dealing with the variety of complex systems. The principle arises from Ashby's (1956) Law of Requisite Variety—only variety consumes variety. On our rookie spy isomorphic map, the Black Box provides for all that happens between the company input and output, that which occurs inside the company walls and that which we metaphorically cannot see. Of course, this interpretation is applicable to the understanding of the recursive levels of structure that exist within the company. Depending on the level of analysis required, there may be a marketing Black

Box, a legal Black Box, and of course the obvious, an accounting Black Box. A good example is common strategic and financial planning decided by company policy makers. After planning concludes, departments strive to achieve particular objectives. The whole company assumes an exceedingly complex, stochastic, homeostatic machine role-play. Periodically, policy makers compare key indicators that seemingly unconsciously emerge from departmental black boxes. The emergent intrinsic behaviors producing the indicators are generally not understood or discussed.

> It is a primary aim of industrial cybernetics to harness this ability of a system to teach itself optimum behavior. To do it, however, it must know how to design the system in the first place as a machine for teaching itself. There must be exactly the right flow of information in the right places; rich interconnectivity; facilities for growth of feedbacks and many one transformation circuits; and so no. The exceedingly complex system must be designed as a black box. (Beer, 1957, p. 57)

It is the overall aim of this paper to tie together a coherent set of action principles that might guide managers to discover the ability of a system to teach itself optimum behavior. The first step involved our fundamental views on the primary definitions and principles of cybernetic theory evolving from *Cybernetics and Management*. The second involves the presentation of a glossary of words, phrases, and (Beer) quotes, in our simplified management language, which we believe may assist in the pursuit of contextual practice (Table II).

4. CONCLUDING REMARKS

The presentation of our view of primary definitions and principles of cybernetic theory emanating from *Cybernetics and Management* is designed to make these principles more accessible to practicing managers. We suggest this view based on applications of Beer's models reported elsewhere (Stephens and Haslett, 2001, 2002a,b,c, 2003). We find our interpretation of the theory and our set of potential action principles to be coherent, supportive, and useful in our contextual work with VSD. We do however strongly assert that a suitable interpretation of the VSD theory base cannot be obtained only from considering the Beer trilogy *Brain of the Firm* (1971), *The Heart of the Enterprise* (1979), and *Diagnosing the System* (1985). Ideally, managers considering contextual VSD would consider all of Beer's works but we realize the practicalities of this suggestion. We contend that a sound set of action principles emanating from Beer's primary works must be considered before tackling the noted trilogy. This paper suggests that Beer's work provides the basis for the development of a model for actionable theory in organizations and takes the form of a three-step process. We commenced the paper with some introductory thoughts into operational research, cybernetics, VSD, and contextual action. Our first step toward action involved some primary definitions

Table II. Our View—Primary Definitions and Principles of Cybernetic Theory

Term, word, or phrase	Common managerial understanding	Our interpretation
Cybernetics	The principle of control and communication in organizational systems	The interdisciplinary (biophysical) science that considers the principles of control and communication as they apply in our companies
Control—"the word control is not used in the way in which either an office manager or a gambler might use it: it is used as a name for connectiveness" (Beer, 1959, p. 9)	The giving of orders and directions to parts of the organizational system	Connectiveness, self-regulation, self-emergence from a system. Human–machine interface
Systems approach	Dynamic interactions of the whole	Either wider or alternatively more compact forms relating to the whole (a) concept of (recursive) layers, (b) interactivity between the bits and the pieces within each layer, and (c) interconnectivity of the bits, the pieces, and the layers
Recursion	(For the same thing) to happen or occur again	The principle of a set of Chinese boxes or Russian dolls. Wherein the same principles are each contained within the next layer of the whole
Categorization of the company as exceedingly complex and probabilistic	In the probabilistic sense, modern management intervening to regulate systems with the confidence that things can be made to go right	To strive for a higher self-regulation system that cannot go wrong
Machine—"now the kind of machine we have been examining is an organism, having its own unity and purpose: thus the metaphor 'machine' is appropriate for mechanical, or animal, or social or formal descriptions. It is this concept, in all its variety, which underlies the search for patterns in most good OR: it might be called the cybernetic model." (Beer, 1959, p. 34) [Our emphasis]	A mechanistic or mechanical function.	A cohesive collection of items, people and information forming some purposive system—"For Beer the issue was to 'discuss the intersection of men and machines in a way which suggests that they form an indivisible synthetic system of a higher type.'" (Beer, 1959, p. 24)

Table II. Continued

Term, word, or phrase	Common managerial understanding	Our interpretation
The company—a homeostatic (a control device for maintaining variables between preferred limits) machine for regulating itself	Where both company input and output calm down so that the operation exists in a steady and stable state—"Mechanistic or mechanical functions sit in the simple probabilistic or simple deterministic categorization of systems and are not part of the cybernetic area under consideration"	Where the normal variable company input and output factors are kept under control by self-regulating feedback systems inherent in the whole system
Stochastic processes	In relation to segregated events, pattern emerging from randomness	The realization that at any point of time specific company variables do produce unscripted behavior. But in general, company behavior does exhibit continuity and display pattern—and what is the nature of this "Beer" machine [internal engine room/parasite] that is producing this behavior?
Internal engine room/parasite—"now let us seek out the secondary machine: the machine that lives inside the first like a parasite; the machine for slowing down and stopping the plant" (Beer, 1958, p. 40)	New principle?	If managers apply primary cybernetic thinking they may be able to investigate and uncover the engine room/parasite components that produce the stochastic, homeostatic behavior evident in viable companies
Open and closed systems	Microcosmic closed system approach to management	The significance of a class of machines not to be considered as either completely open or completely closed, but as quite simply having inputs, outputs, and feedback

Table II. Continued

Term, word, or phrase	Common managerial understanding	Our interpretation
Isomorphic (having a similar form) mapping	New concept?	Reveals how the mapping of discovered information inherently diminishes the initial complexity emerging from the company operation
Variety dial—"it is a primary aim of industrial cybernetics to harness this ability of a system to teach itself optimum behavior. To do it, however, it must know how to design the system in the first place as a machine for teaching itself. There must be exactly the right flow of information in the right places; rich interconnectivity; facilities for growth of feedbacks and many one transformation circuits; and so on. The exceedingly complex system must be designed as a black box" (Beer, 1957, p. 57)	New principle?	Control emerging from the company engine room/parasite is likened to the metaphor of a sound system volume control. Management turn up (ameliorate) or turn down (attenuate) informational "volume" in the pursuit of company homeostasis
Black box: A categorical, inaccessible system, which must be adopted to provide for the process of dealing with the chaotic variety of complex systems—"remember that no brain and no computer does or ever can exist that is large enough to accept all facts and to permute them against each other as a means of finding the best set of relationships" (Beer, 1959, p. 229)	New principle?	The whole company has assumed an exceedingly complex, stochastic, homeostatic machine role-play. Periodically company policy makers compare key indicators that seemingly unconsciously emerge from departmental black boxes. The emergent intrinsic behaviors producing the indicators are generally not understood or discussed by the policy makers
Ashby's (1956) Law of Requisite Variety—only variety consumes variety	New principle?	Managers need to be smarter than the situation they are trying to manage

and principles of cybernetic theory and the prospect of controlling overwhelming variety. Our second step provided our set of coherent potential action principles fundamental to cybernetic theory. We believe the well-informed manager may now readily use our principles to better provide for the implementation of VSD into third step contextual practice.

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