Chapter 1

From System Science—A New Way to Structure and Manage the Company

Over the post World War II years of the 20th century business success depended mostly on variables business people could get their hands on, understand, and manage reasonably well. “Out there” were opportunities, and the world provided resources to transform into product and service values to develop those opportunities. Environmental antennas were tuned to market needs, technology, and competitive actions, increasingly global. All these provided a flow of information and resources that spurred great economic growth. From 1950 to 2000 world population increased from 2.5 billion to 6.0 billion, up 140%. Over those same 50 years, global economic output (in 2001 dollars) increased from $7 trillion to $46 trillion, up 557% [1]. These trends, and where they are going, change everything.

A TIME FOR CHANGE

Over the later years of the century new and different environmental influences developed; accumulated. What we could control became less and less the key to success, and change “out there” more and more important. In all dimensions, the world changes, kaleidoscopically, and

Holistic Management, by William Christopher
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fast. This new world of challenge and change presents both threats, and opportunities. For the timid change is frightening; for the satisfied change is threatening; for the confident change is opportunity.

For the wise, their guide for the times ahead will be system science, cybernetics, and a viable system model (VSM) for organization structure and management. For the turbulent times ahead, the VSM with its system science and cybernetics gives us a new and different view of our company and how it works, and gives us new management principles that greatly improve company performance.

Everything in our experience can be thought of in systems terms. Nothing stands, or happens, on its own, in natural systems, and in the system that is our company. Everything relates and interacts within a system, and in relationships with other systems, and it is the system and these interacting relationships we need to understand and manage. As Stafford Beer wrote [2]:

It is characteristic of man’s way of thinking to contemplate entities rather than systems: to disconnect systems rather than to relate their parts; to record inputs and outputs to systems rather than to measure systemic behaviour itself. When it comes to managing affairs, we characteristically try to deal with the dismantled system—piece by piece—rather than to redesign the totality so that it actually works.

The VSM with its system science and cybernetics gives us a way to understand the totality of our company and how it works, and gives us better ways to structure and manage the system that is our company.

With the VSM and system science we see the company with new eyes, and manage in new ways. Figure 1.1 illustrates a simplified system model of a company. This model will be developed in more detail in Chapter 2. A system model is much different from the typical organization chart. The system model doesn’t show people and titles. It shows functions and relationships. It includes the environment outside the company. It includes communication channels and specifies information flow. Stafford Beer, a pioneer in the application of system science and cybernetics in management, developed the system model presented in this book, the Viable System Model (VSM).

SYSTEM SCIENCE AND THE VIABLE SYSTEM MODEL (VSM)

Over the years, the hard sciences and the soft sciences developed in an increasing number of separate disciplines. As we learned more and
more about each, each began to intrude into the realms of others. Physics and chemistry intruded into biology; biology into sociology, and the boundaries of the social sciences blurred. The sciences, whether technical or social, became more and more interrelated. Scientists began to realize that reality can not be understood completely through classification and analysis. Something more was needed. The “something more,” a synthesis, was discovered and developed over the years following World War II by Ludwig Von Bertalanffy, Norbert Wiener, Ross Ashby, and others. The work of these pioneering scientists discovered and developed a new science—system science and cybernetics. System science defines what systems are, their characteristics, and how they function and interrelate. Cybernetics, a part of system science, is the science of communication and control in systems. From system science and cybernetics we now have a general systems theory which tells us all that science now knows about how things work, interrelatedly, in nature, and in human society.

Instead of analyzing the parts, system science takes an holistic view. System science gives us an holistic world of holistic parts. Systems science studies the total system and sees systems with holistic parts
interacting within the system for a purpose. In a natural system, that purpose is survival. In a system that is a corporation, purpose is survival and something more. Companies are purposeful. They have a purpose more than survival. They have goals they intend to achieve. System science offers management a new view of the company showing more clearly what the company is and how it works. With this new view and understanding, management will manage differently, increasing the capability of the organization to accomplish desired results.

System science has discovered that all systems share common characteristics and behaviors, and these have been identified and described. We now have scientific knowledge of how feedback and communication within the system enables a complex system to interact in ways that will achieve its purpose.

In recent years Stafford Beer, Russell Ackoff, Paul Rubinyi, and others have applied system science to the operation of business enterprise. In systems terms, a business unit, a business group, a company, a corporation are each a viable, very complex, purposeful, probabilistic system. The complex, probabilistic system that is a corporation has the kind of structure and the characteristics discovered by the new system science. But without a knowledge of system science we don’t see the structure, and don’t understand and make use of some of the characteristics of system behavior that can much improve performance.

System science does not tell us how our company or business unit should function. System science tells us how our company or business unit does function. And that is different from the views most commonly held by management people today. When we understand how to use system science, we will be able to design and manage the system that is our company or business unit so that it can more effectively achieve its purpose. Stafford Beer developed the viable system model (VSM) to represent and describe the system science and cybernetics needed to manage effectively a business, a corporation, or any other kind of organization.

A simple analogy may help in understanding the value of system science in management. The human body is a very complex system and has functioned in the same way for many thousands of years. But to deal with the health and the pathology of the body, quite different methods have been used by “experts” of different cultures and different times. The physician of ancient Greece, the Mayan priest, the Australian aborigine, the Indian medicine man, and the blood-letting barber were all treating the same system, the human body. But their interventions weren’t always helpful. Over more recent years our knowledge of
the system that is the human body has increased tremendously. With new knowledge, our treatment of the body’s pathology has much improved, and life expectancy has increased by decades. Might we not also expect improvement in our management methods as we increase our understanding of the system that is our business enterprise?

System science gives us new ways to steer the business enterprise to the achievement of its purpose. Seeing with new eyes shows as new ways to manage today’s complexities and more successfully achieve desired results. Internal measures and interactions with the environment provide continuing feedback that coordinates all efforts toward the achievement of company purpose. This same feedback provides information for changes in structure when needed to improve performance.

**BENEFITS FOR MANAGEMENT**

When we use systems science and the VSM to structure and manage our company:

- We learn, adapt to change, and evolve so that we are able to maintain continuing success over time, under changing circumstances
- We are neither centralized nor decentralized; we are both at the same time
- Control is not imposed from a higher level. Control is designed into the structure so that each unit can be self-controlling
- Feedback from the work itself enables self-control
- Measures of progress toward objectives provide on-going guidance toward desired objectives
- Since measures reduce complexity they are developed with great care not to lose information that matters
- Information is available where and when needed for decisions and actions
- Each level does its own planning. There need be no passing of planning documents between levels
- Budgets can be prepared in days or hours, not months
- Recognizing and coping with error is part of learning and continuous improvement
- Each unit succeeds by measures of success developed in that unit in consideration of the purpose of that unit
- Unit successes contribute to the achievement of company goals
System science and system thinking give us a new way to see and understand our company. This new understanding at all levels provides prompt awareness of threats and opportunities, and new ways to manage for improving performance.

The times we work in are filled with change signals. Technology change signals new threats and new ways for creating value. Terrorism signals new threats. Ballooning world populations with many uneducated, unemployed, and poor signal both threats and opportunities. Changes in our ecosphere signal threats, and offer opportunities. How well do prevailing business structures and business practices detect these and other signals, and take actions needed for survival and long-term success?

New successes will be different from the old. Environmental changes—technical, commercial, economic, political, social, and ecological—signal new needs, new opportunities, new threats. New and different information and new inventions will be needed. Structuring the company using system science principles increases awareness of threats and opportunities, and improves the ability for quick response.

In the sciences, in society, in industry, in technology, in our understanding of nature; in all that we do or are aware of, complexity abounds; and grows explosively. How do we find the fundamental simplicities to guide us? Years ago a scientist and corporate executive commented to this author that civilization is a race between complexity and simplification. At that time, in the 1950s, the race seemed challenging, but manageable. But today that race has new dimensions not foreseen in the 1950s: (1) hugely expanding, and conflicting, human populations worldwide, (2) rapid expansion of industrial production to meet ballooning needs, (3) derivative of these first two, threatening changes in the ecosphere that is the home of all life, including ours, and (4) growing social instability. How do we structure and manage our business enterprise for success today and sustainable success through the years ahead?

System science and cybernetics give us a great simplifier for the complexities of management. That’s the message of this book—simplifying the complexities of management at a new level of understanding; improving control; improving performance.

**ORIGINS OF SYSTEM SCIENCE**

System science and system theory developed from the work of pioneering scientists striving for a more complete understanding of the growing
complexities in the separate disciplines of science. When complexity grows beyond comprehension, and the new learning no longer fits prevailing conventions, there can suddenly appear new knowledge that simplifies all the complexity at a new level of understanding. System science and general system theory offer that new level of understanding for business management.

The work and writing of Ludwig von Bertalanffy, Robert Rosen, G. J. Klir, W. Ross Ashby, Norbert Wiener, and many others has advanced system science to the point of an established general system theory that we can now apply in many realms, including management. In his book, General System Theory, Bertalanffy states that “. . . systems theory is a broad view which far transcends technological problems and demands, a reorientation that has become necessary in science in general and in the gamut of disciplines from physics and biology to the behavioral and social sciences and to philosophy. It is operative, with varying degrees of success and exactitude, in various realms, and heralds a new world view of considerable impact [3].”

Those not interested in seeing and understanding their company in a new and different way might ignore system science, thinking, “that’s just a theory.” But a scientific theory is not something to be ignored. In all realms, science studies, analyzes, assembles data, reports findings, proposes hypotheses. Then, from all that’s known, comes theory. Scientific theory is the understanding that best fits all that’s known about that subject area. All the research, all the facts, all the studies, all the data support the theory. Denying theory is denying the existing knowledge on that subject. Instead of denying system theory, embrace it. Business people who learn about system theory and apply what they learn in structure and operations, will improve the capability and the performance of their organizations.

Stafford Beer’s viable system model (VSM), used with a knowledge of the system science and cybernetics embedded in the model offers a new understanding and a new way to structure and manage businesses and other organizations and institutions. But before we can use the model, we need an understanding of the science of systems.

WHAT IS A SYSTEM?

We use the word “system” every day, in ordinary conversation. A computer becomes a computer system; a furnace, a heating system. Manufacturing resource planning (MRP) is a software system, as is customer
relationship management (CRM). The software industry seems to have claimed the word “system” as a proprietary attribute of their products. To get a driver’s license we “follow the system.” Note how often we hear, or see, or use the word, “system.” Sometimes the meaning is clear, and specific; sometimes fuzzy. But always it is combining something with something in addition. That’s true in system science, too. But in system science we will be specific in how we define “system.” In system science, “system” is not the system of everyday conversation.

We can begin with two broad classifications of systems:

Deterministic
Probabilistic

Deterministic systems can be simple, or complex. See Figure 1.2. In a deterministic system we know all the parts, what they do, and their relationships with other parts. When the system fails to work properly, we know how to find and fix the problem. To improve the system we know where improvement would be beneficial, and we know how to go about designing an improved system. A home heating system is a simple, deterministic system. The thermostat is the controller, automatically controlling room temperature to the setting on the thermostat. We used to set the thermostat manually. Now, with digital technology, we program the thermostat for a week for desired temperatures each hour, each day, for both heating and cooling. We can even program remotely.

An automobile is a complex, deterministic system, with the driver-controller and many built-in controllers all activated when the driver drives the car. We know all the parts of the system, what they do, and how they do it. A fleet of cars (company cars, delivery cars) is a more complex system. Each car is a deterministic system, but the fleet management part of the system, how all the elements will perform—cars, drivers, scheduling—is probabilistic.

![Figure 1.2 Kinds of systems](image-url)
Probabilistic systems can be complex, or very complex. We know all the parts, but the behavior of the parts will vary, as will the relationships among the parts, and the interrelationships with other systems. Instead of determined, and known, everything is probabilistic. A small business is a very complex, probabilistic system. A large corporation is a very complex, probabilistic system. We will manage both the small business and the large corporation in new ways when we understand them as viable, very complex, purposeful, probabilistic systems. Managed by the principles of system science as expressed in the VSM, our companies will be more capable of achieving desired performance.

If our business or our corporation is a very complex, probabilistic system, what are the parts of that system? Here we come to the recursive nature of systems. Our business, or our corporation, is made up of subordinate systems each with the same complex, probabilistic characteristics as the total business or corporation. And our business or corporation is itself a part of a still larger, more-encompassing system, typically the industry that the company is a part of. And the system that is the industry is a part of a still higher-level system, the economy. What we learn in system science applies in all of these. In this book we deal with the applications of systems science, system thinking, and the VSM in the total company, and the systems at all levels of recursion within the company. All of these can be modeled with the VSM; all have the same system characteristics.

General system theory and system science give us an understanding of these systems and their characteristics. Figure 1.3 illustrates a basic design for any business system.

The business system includes operations (the circle), management of those operations (the square), management systems used by management (the triangle), and the environments outside the business (the amoeboid shape); all interlinked by communications channels. We draw the diagram in this form to show relationships and communications. In actuality business systems is embedded in management; management is embedded in operations; and all three together are embedded in the environment, as shown in Figure 1.4.

Some systems seem quite obvious; they are on the organization chart. The corporation. A business group. A business. A plant. In this book we will define each of these as a system that can be described in a new, different, and better way with the viable system model (VSM).
This book describes the business enterprise as a viable, very complex, purposeful, probabilistic system comprised of viable, very complex, purposeful, probabilistic systems:

- Viable: capable of continuing to exist in its environment
- Very complex: so complex in its operations that only the coordinated capabilities of all its members and a carefully designed information structure and information flow can control operations to assure viability and the achievement of performance goals
· Purposeful: capable of achieving desired goals
· Probabilistic: the behavior of the parts of the system are probabilistic and unpredictable, but can be guided toward desired outcomes

Stafford Beer’s viable system model and the discoveries of system science give us new concepts of structure and new ways of management. VSM and system thinking give us an order of magnitude simplification of the complexities of management. At a higher level of understanding, we manage more effectively. Performance improves.

**CYBERNETICS**

Norbert Wiener gave the name “cybernetics” to the science of communication and control in systems. His 1948 book, *Cybernetics: Or Control and Communications in Animal and the Machine,* describes how information and communications control systems. Beer describes cybernetics as “the science of effective organization [4].” Whatever the system, a deterministic system like a machine, or a complex system like an animal or a human being or a complex, probabilistic system like a corporation, information controls how the system works and what the system does. To enable this control, information becomes an important part of structure. The VSM specifies communication channels and the information flowing in each. In the VSM, information is a part of the structure of the company.

System science has a lot to say about control. When we see the company as a system made up of subordinate systems we begin to get some new ideas about control. Traditionally we have thought of control as imposed on a function or a unit or a company by a higher-level authority. That’s a natural impression from the pyramidal organization charts we draw and present as a description of the company. And control from above is an impression many of us get from our experience in our jobs.

When we see the company as a group of interrelated systems and understand what systems are and how they function, our minds open to new ideas. We can see that information is an important part of structure, and that the communication of information can be structured so each system can control itself. So the task of management is less imposing control, and more structuring the system so that it can control itself toward accomplishing desired results.
Another consideration in control is the typical concentration on priorities. Typically, with limitations on resources, executives struggle with priorities. For example, at budget time, executive management may project an ability to fund $XX in new capital expenditures for the year ahead. But proposals come in for $XXXX. This kind of a problem is resolved by priorities. The $XXXX is prioritized down to $XX, often by such financial comparisons as discounted cash flow return on investment, or payback. The VSM and system thinking give us new ways to think about and deal with this kind of situation. Priorities and prioritizing disappear, replaced by different and better decision methods as explained in Chapter 5.

Cybernetics, the science of communication and control in systems, offers three new concepts for management that enable self-organization and self-control: variety, requisite variety, and black boxes.

Variety

In systems science, “variety” is the measure of complexity. Businesses are very complex, probabilistic systems. Complex is obvious. Probabilistic we probably haven’t thought much about. A home heating system is not a probabilistic system. We know the parts and we know exactly how they work. If we set the thermostat to seventy-two degrees we get seventy-two degrees. If we get sixty degrees, we know how to fix the system to give us the desired result. In our company we know all the parts, but how they work is a matter of probability. We can put sales revenue of $X in the budget and intend for sales to be $X. We know the parts of the system that produce sales results. But sales will always be some variation of $X. If sales are $X minus 30% we don’t immediately know what to do to give us the desired result. Or, if sales are $XX is there new opportunity out there? The VSM and system science offer management methods for discovering and fixing problems before they show up in reports, and for identifying and developing opportunities.

We can put a time line and checkpoints for specified deliverables in a project plan. But when the checkpoints arrive we will likely see differences from the plan. With system science and system thinking we continuously monitor performance and modify the project plan to stay on track toward the project objective. Everything in business is probabilistic. System science helps us follow a heuristic path toward achievement of objectives.
In all elements of the company we are dealing with probabilities. Multiply all these probabilities by all that’s going on in the company, each individual in his/her job, each team, each process, each unit, each interaction with customers, everything. The measure of complexity is enormous. Variety, the measure of complexity, is defined as the possible states of the system. Variety can actually be measured in very small parts of small business systems. In Chapter 3, the case example titled “How the VSM Helped Transform a Manufacturing Company in Crisis,” the variety in carrying out five production jobs was calculated at 27.5 billion. And that’s in one small part of one small business. For a total business, even a small business, the total variety in the total company would be a meaningless number, too huge to comprehend. While variety is not precisely countable, it can be approximated. We can make comparative statements. We can say that the variety in operations is much greater than the variety in management. We can say that the variety in the company’s environments is very much greater than the variety in all areas of the company that are dealing with these environments.

Variety, of course, is a word in common usage. There’s a variety of choices. People like variety in their work. Which variety of strawberry is the sweetest? The systems definition of variety is completely different from the common usage of the word, variety. In system science, variety is a new word. Variety is a new concept, and a very important concept.

Immediately, we can see that the variety in a corporation is far more than the ten thousand million neurons in the brain of the CEO can comprehend. Nor can this huge variety be matched and comprehended by the ten thousand million neurons in the brains of each of the company executives, combined. The task of management is to lead all this probabilistic complexity, this huge variety, toward the achievement of company goals. System science and the VSM shows us how.

In system science we don’t see the CEO and top executives as “running” the company. Instead system science sees the CEO and senior executives as structuring the corporate system and its recursions—the viable systems that are its operating units—so that the company can run itself toward the achievement of company goals. When problems arise, the system itself can usually resolve, or dissolve, the problem. Or, if necessary, higher-level management can change the system so that the system itself can resolve the problem and achieve desired performance results.
Requisite Variety

W. Ross Ashby, one of the pioneers of systems science, formulated the basic law of control, known as “Ashby’s Law.” Ashby’s law states, “Only variety can absorb variety.” That’s a very precise statement in the language of systems science. Applying this law to business management, it says that all the probabilistic complexity throughout the corporation can be effectively controlled only by an equivalent amount of probabilistic complexity in the controller. In a corporation, how can that happen?

Variety is defined as the possible states of the system. In even a small business the states of the system—the actions behaviors, and results of all the employees, all the machines, all the processes, all the equipment, all of the interactions among all of these, and all of the interactions of all of these in their relationships with people and organizations outside the company, and all the company interactions with all the company’s environments becomes a number beyond human comprehension.

We can’t put useful numbers on variety. The numbers are too huge. But we can make comparisons. And we know that the variety in operations and in the environment is vastly greater than the variety in management. What attenuation of the variety in operations and what amplification of the variety in the management of operations can establish requisite variety? What attenuation of the vast variety in the environment and what amplification of the variety in the company areas dealing with the environment can establish requisite variety? How can we make the control variety equal to the variety in what is being controlled?

In operations, traditional measures like ROI and ROS are huge attenuators of variety that lose a lot of information needed for wise decisions. Aggregations and averages also lose huge amounts of information needed for decision-making. Measures like sales revenue, cost of goods sold, gross margin, ROI and other aggregated accounting measures too often are used by higher levels of management to make decisions better made at a level where there can be requisite variety. In system management we aim to make decisions at the levels where there can be requisite variety.

How can the huge variety in operations and in the environment be attenuated, and the variety of management be amplified to achieve requisite variety? Great reductions of the variety in operations will be needed. Even greater reductions in the variety in the company’s envi-
environments will be needed. Eliminating much of the variety loses a lot of information. To avoid losing needed information, we need to go about the attenuation of this variety with care. We need much less variety in operations and in the environments in order to match the variety in management. But we need all the variety that matters.

Management attenuates the huge variety in operations and in the environment first of all by selecting what it is in each of these that matters for the achievement of their business’ short-term and long-term goals. This selection of what matters is a responsibility of management through all levels of recursion. The answers will be different. In each business unit there will be differences in what it is that matters in operations. But there will be similarities, too. Selection of what matters will be the responsibility of individuals close to and doing the work. Many individuals will be involved in making these selections.

Selecting what matters in each business’ environments determines what to monitor and what to measure. Measures can be qualitative or they can be numbers. In either case, change and trends matter and need to be observed to determine appropriate actions. Attenuating the immense variety in each of the company environments by selecting what matters and by measures of what matters makes requisite variety possible. Possible, but not assured. While variety has been reduced by measures of what matters, there is still a lot of variety to deal with. To match this variety will require amplification of the voice of management. This means that many will be involved, not just a few.

After the selection of what matters, we further attenuate variety in this still very great variety by our selection of measures. At the corporate level and at each level of recursion from recursion 1 to recursion X, measures and trends of measures are designed into the information system. At the corporate level and at each level of recursion, measures are an information resource needed to accomplish desired goals. So the design of measures to provide this information must be carefully done at all levels of recursion. Chapters 5 to 11 Offer suggestions on the design of measures.

A word of warning! What may be out there in the environment and in operations that really matters and is not captured in any measure? With conventional measures, much of the variety that really matters can be lost. Ignorance is the greatest attenuator of all. By ignoring variety that matters, decisions can be made, but not well. Only requisite variety can make wise decisions. All decision-makers need a continuing awareness of Ashby’s Law of requisite variety. Effective management makes decisions where there can be requisite variety.
As noted above, the CEO and all corporate executives together are not enough to comprehend the huge variety throughout the corporation. Without knowledge of systems science, many executives today use two methods, typically both at the same time: (1) delegation, and (2) ignoring most of the variety.

Delegation is an improvement. Delegation adds to the variety of the controller. But depending on how the variety in the environments and in operations has been attenuated, may lack requisite variety. Ignoring most of the complexity seems to work, because decisions are made and actions taken, often through reliance on simple measures such as sales billed, ROS, gross margin, or ROI. But how useful are these measures for determining corrective actions? Each problem is a result of many complex interactions involving various functions and many company people and, very often, many people outside the company that company people deal with. Decisions made without requisite variety will likely do more harm than good.

System science and the VSM give us the means to make control decisions throughout the company at locations where there can be requisite variety, locations where the information exists to make good decisions. Requisite variety in the controller is achieved in two ways:

1. By amplifying the variety in the controller through self-control at all levels of recursion and making decisions where the work decided on is done. With many more people throughout the organization doing the controlling, each with their ten thousand million neurons of capability, the variety in the controller greatly increases.

2. By attenuating the variety in operations and in the environment by:
   (a) first, selecting wisely what is important to the successful achievement of organization goals, then
   (b) selecting and monitoring useful measures of what is important.

When operating decisions are made at higher-levels of management lacking requisite variety, the decisions ignore most of the variety needed for wise decisions. Authority does not grant requisite variety.

Corporate management can have requisite variety for defining the company and its boundaries, and for structuring the company to control itself. From monitoring company performance and the company envi-
ronments, corporate management also can have requisite variety to revise the definition and boundaries, and to make changes in structure as may be appropriate. Corporate management can achieve requisite variety for those decisions. But corporate management can not intervene within lower level operations. They lack requisite variety for decision-making in lower level operations. These operations are black boxes from the perspective of higher-level management.

**Black Boxes**

Systems are variety generators. A black box is a high-variety operation within a system whose operations cannot be known to higher-level management. Higher-level management lacks requisite variety. Higher-level management can know the purpose of the black box, can know the inputs to the black box, and can know the outputs from the black box. But what goes on inside the black box is unknowable, except in a general way. Higher-level management cannot intervene wisely within the black box, cannot make informed decisions within the black box.

For corporate management, each of the operating businesses in the corporate VSM is a black box. The immense complexity within the operations of a black box can only be managed effectively within the black box. Higher-level management interventions within the black box will more likely hurt than help. Higher-level management has the authority to make such interventions and often does. But higher-level management, while it has the authority, lacks the variety to make wise decisions within the black box. Ashby’s Law prevails. And the people within the black box are left to recover from the consequences of interventions from above. See Figure 1.5.

The cybernetics concept of black boxes helps management improve organization performance through indirect management that increases requisite variety where decisions are made. In a corporation, the next level viable systems, its operating units, are black boxes to corporate management. Corporate management does know what goes into the black boxes—resources (people and capital), materials inputs, purpose, and information. Corporate management also knows what comes out of the black boxes—outputs defined by performance measures. But corporate management lacks the requisite variety to comprehend and understand the complexities—the variety—of all the transformation processes within the black boxes. The higher level lacks the requisite variety for control capability. Only the black box itself has control
capability. Any higher-level management intervention in an operating unit to fix something gone wrong, such as unsatisfactory profitability, will more likely make matters worse, not better. As Stafford Beer stated [5]:

The major problems arise when matters are not going well—or at least when it is obvious that ‘something needs to be done.’ Managers, the men themselves, are then expected to take some kind of action. I think it is a major cybernetic conclusion to draw from these remarks that managers generally approach this problem in the wrong way. They usually try to intervene in the equilibrial processes of the self-regulating system—thereby, perhaps, making it fundamentally unstable. The sensible course for the manager is not to try to change the system’s internal behavior, which typically results in mammoth oscillation, but to change its structure—so that its natural systemic behavior becomes different. All of this says that management is not so much part of the system managed as it is the system’s own designer.
How does higher-level management assure control within the black box? By the design of structure and information flow so the black box can be self-organizing and self-controlling. If the operating system that we are now defining as a black box is unable to produce desired results, the remedial action by higher-level management is not to go into the black box and fix the problem. That would most likely make matters worse. The remedial action that works is to change the system so that it is capable of producing the desired results. Changing the system involves changing people, changing resources, changing information, or some combination of these three. Often, changing information is enough—some different and better management methods, and different and better measures. See chapters 5 through 11 for useful management methods and measures.

Indirect management uses the concepts of the Resource Bargain which defines each business and its boundaries (see chapter 2), requisite variety, black boxes, and self-organization and self-control to assure effective control throughout the company for success today, and for the times ahead.

HOMEOSTATS AND HETEROSTATS

A characteristic of any system, including a system that is a business, is homeostasis, a tendency to maintain itself in its present state. Specific elements in the system, or actions of elements in the system, identified as homeostats, work to maintain the present state of the system. A good design of the corporate system includes well-designed homeostats. But in business we will call them by different names.

The highest level homeostat in a company is the board of directors, and company top management. One of their key responsibilities is to keep everything on an even keel, and prevent or resolve any serious internal or external conflicts. At the operating level, in most companies, we find homeostats mostly missing, and the function poorly performed. The VSM includes organized homeostats, coordinating operations to prevent internal conflicts and to resolve them when they do happen. See the description of system 2, and the system3/system 4 homeostat, in chapter 2.

Systems, and especially systems that are businesses, also have a characteristic of heterostasis, a tendency for change, learning, evolution, creativity, improvement, innovation. Specific elements in the system, identified as heterostats, work to change and improve the system.
Heterostats can produce continuous improvement. Heterostats can also produce innovation, rapid change, transformation. The VSM design of the corporate system includes effective heterostats, providing a creative tension between homeostasis and heterostasis that enables the company to do what’s right for the present while also discovering the innovations that will create the company’s future. Every company needs well-designed heterostats, but in business we call them by different names. See chapter 8.

**RECURSION**

Stafford Beer uses the term, “recursion,” from number theory, a branch of mathematics, to describe a very important attribute of viable systems and the viable system model (VSM). System science says that any viable system is comprised of viable systems and is itself part of a higher-level viable system. There can be many levels of recursion in both directions. While the higher-level recursions and the lower-level recursions will be very different, the viable system model is exactly the same at all levels of recursion. The VSM with its systems science and cybernetics defines a viable system, any viable system. Applied in a company, the concept of recursion provides a vast attenuator of the huge variety in the structure and operations of any large company. The VSM models the corporation. It also models the corporation’s business groups, the individual businesses within the groups, and operating units within those businesses. Each can be modeled with the VSM. See Figure 1.6.

Figure 1.6 shows a VSM model of a corporation that has its operations organized into 4 business groups. The figure then shows the first level of recursion, showing the model for corporate group 3, which we see is comprised of 5 companies. For the entire corporation, there will be a total of four VSMs at this level of recursion, a model for each of the Groups. Each of these, of course, will show the number of companies in each of them. Going to the second level of recursion using group 3, Company 2 as an example, we see that company 2 has four profit center businesses. Similarly, at this level of recursion there will also be VSMs for the companies in each of the other groups. Going to the third level of recursion, Figure 1.6 shows that business 4 in company 2 has three plants producing the company’s products. Similarly, the third level of recursion will include the VSMs for all the company businesses in all the other companies in all four groups of the corporation. And we could go on to additional levels of recursion.
Typically we look first at the corporate VSM as recursion 0, the system in focus, and the first level of recursion, recursion 1. Or the interest might be at a further level of recursion as the system in focus, and its next level of recursion. Corporate management focuses on recursion 0 and recursion 1. The MX Corporation example in Chapter 3 describes how the VSM was used to improve operations and profitability two recursions from the corporate VSM as the system in focus.

People trained in financial analysis may confuse the idea of recursion with their practice of “drilling down” from a higher level through levels of management to get information from a lower level for their analysis.
of that level’s operations. Recursion is an unrelated and completely different concept. In the VSM and its recursions there is no “drilling down.” Lower levels are “black boxes,” unknowable to the higher-level. Drilling down can produce additional data, but cannot produce useful information. Using the VSM, companies will rethink their practices of financial analysis and “drilling down” to appraise lower-level operations. The higher-level lacks requisite variety, and such practices result in misleading information, and misguided interventions.

With system thinking and the VSM, for a large corporation, we see not a hierarchy, but a web of inter-relating viable systems. Visualize this web not as a growing cascade descending from the corporate VSM. Instead visualize this web as spreading in all directions and planes, with the corporate VSM among them. For the first level of recursion there may be 3 to 8 VSMs. At the second level of recursion from each of those 3 to 8 there may be 3 to 8 VSMs, bringing the total to something between 13 and 73 VSMs. Stafford Beer in his book, *Brain of the Firm*, compares recursion with a neural network. See Figure 1.7.

![Conventional view of an organization](image1)

Conventional view of an organization

![How the organization really works, showing the same elements](image2)

How the organization really works, showing the same elements

**Figure 1.7** A viable business system as a neural network
The first part of Figure 1.7 shows the typical organization chart of a business. The figure shows a corporation with three units at the first level of recursion. At the second level of recursion, each of these three units is also made up of three units. Each of these units could be modeled with the VSM. More typically, in a large corporation the number of units (VSMs) at each level of recursion will be some number from three to eight.

The bottom part of Figure 1.7 shows the same units as they interrelate in a neural network, which Beer says is the way businesses really work when understood as complex, probabilistic systems. He makes a good point. This neural network illustrates a corporation with two levels of recursion totaling 13 units (VSMs). Visualize this neural network with two levels of recursion totaling some 50 units (VSMs). We might be more comfortable visualizing an interconnected web, rather than a neural network. Whether a neural network or an interconnected web, the concept of hierarchy changes.

Visualize a multidimensional, interconnecting web of viable systems, each:

- with the functions and capabilities of a viable business system
- capable of self-organization, and
- capable of self-control.

With this view we can begin to understand how system science and system thinking can give us new ways of managing for success today, and for creating success tomorrow.

Typically we begin with modeling the corporation into the VSM. There’s much more involved than transposing the traditional organization chart into a different format. The usual company organization chart identifies executive positions and major units of the corporation. The VSM identifies the corporation’s viable systems—its component businesses. The VSM also identifies functions and relationships, establishes communication channels, organizes information flow, and includes all external relationships.

The VSM looks very different from the traditional organization chart, but for all the information it includes is simpler. The company organization chart is a partial view of corporate structure, identifying the major parts of the corporation, and showing who in management reports to who. The VSM shows a different and deeper structure of the corporation, defines the corporation and all of its parts, describes how they work and interrelate, and specifies what they do (their purpose). A system is what it does.
This same VSM model is used at all levels of recursion. The corporate VSM identifies the next recursions of viable systems, the corporation’s businesses, or groups of businesses. After developing the corporate model, the next step is to develop the model for its viable system businesses. And this process can be carried out by management groups throughout several levels of recursion. The point, of course, is not to have models, but to discover new guidelines for leaders that will simplify management, and improve performance results.

**INFORMATION**

In systems science and system thinking, we see how information controls actions, in natural systems and in business systems, too. The human body is a complex system. We run up the stairs (our conscious decision). Messages are sent by the nervous system to leg and arm muscles to move as needed, without any conscious awareness. The autonomous nervous system senses a need for energy and sends a message to the heart to increase circulation. Energy, breathing, respiration, digestion, white corpuscle attack on invading pathogens; unknown to us sensors and information flow within our bodies keep our bodies functioning normally. Our homeostats are working. Similarly homeostats throughout the company keep operations running normally without any conscious awareness by higher-level management. The corporate management responsibility is the design of the corporate system to coordinate and motivate all actions toward the achievement of company purpose. From monitoring performance measures and environmental change, top management can modify structure (resources, people, information) when appropriate so the system itself will perform as desired. The VSM shows us how.

The viable system model includes communication channels, and the specification of the information flowing in these channels. Mapping communication flow in the corporate VSM, and with local managements doing the same at each level of recursion, establishes effective control throughout the company. The appropriate measures at each level of recursion being used by the people at that level, can meet the requisite variety requirements of Ashby’s law. Through the wise development of measures, the variety in local management can control the variety in their operations. In today’s world, new kinds of measures are needed.
Throughout this book, there is a strong emphasis on measures. Ashby’s law and the management need for requisite variety between controller and what is controlled will require simplifications. To simplify, we will need to reduce, or “attenuate,” the huge variety in operations, which is both very complex, and probabilistic. We attenuate the complexity through selection of what matters, and well-designed measures of what matters. We take big chunks from that variety and represent those big chunks with specific measures. Those measures can’t contain as much information as is contained in the chunks of variety that the measures represent. But if we choose our measures well they can include what is needed for good, practical, and effective decisions and actions where the work is done. Many of these measures will not be the measures we see in our traditional accounting reports. They will not be aggregated measures from periodic reports. See chapters 5 through 11 for useful measures in the key performance areas that determine company success.

**TRANSDUCTION**

The VSM includes communication channels. And in developing the VSM at each level of recursion system principles specify what information flows in each of these channels. Included will be the measures selected to attenuate variety.

In systems terms, we need “transduction.” Wherever information enters a communication channel, what goes into the channel has to be entered into the channel in language or form that can be understood by the receiver. If we have chosen our measures well, the measures will be in a form the receiver will understand. The transducer may receive data; but it will send measures.

In addition to measures, there will be many other kinds of information flowing in the communication channels, as described in chapter 2. In volume, measures will be a small part of the total, but a very important part. For all that goes into the communications channels, the transducers will assure that it will be in language and form that will be understood by the receiver. The transducer will have information needed for a higher-level financial report in the right account numbers and language for the receiver. Information for a compliance report will be in the language required for that report. Information on the performance areas described in chapters 5 through 11 will be measures understandable and useful to the receiver.
SELF-ORGANIZATION

Systems have a capability for self-organization. No central authority organizes the ecosystem of a forest or a saltwater marsh. Like all natural systems, they organize themselves to live in their environment. Bring a group of people together for the purpose of building a playground in a public park, and the group will soon be an organized effort to accomplish that goal. The internet organizes itself.

Self-organization is a characteristic useful to management at all levels of recursion for increasing organization capability. In a corporation, the top executives together with others can develop a viable system model for the total corporation. That requires some learning time, and the collaborative effort of a number of people. But it is not a huge task, if minds open to the principles of system behavior as discovered in system science.

A presentation of system science principles and a first-draft VSM of the company can be completed in a half-day session with top management. But several months will be needed to really understand the VSM, organize all the required functions, determine goals and performance measures, and structure information and communication. All key players in the corporate VSM will be involved in the process. A few months can bring good and very useful results, a big improvement from the conventional organization chart and management methods. But it will not be the optimum. There will be a continuing learning from experience as understanding of the VSM and system thinking grows at all levels of recursion.

Developing the corporate VSM, understanding the functions and the system thinking the model represents, and deciding on goals and measures is self-organization in action. And this will happen at each level of recursion. Over time, many will be involved. The result becomes a system structure for continuously improving organization capability.

The corporate VSM identifies and defines the corporation’s subordinate viable systems. Then the management group in each of those viable systems, which will be the businesses comprising the corporation, go through the same kind of self-organizing process to develop a Viable System Model for their operations. Developing the VSM, they learn the system science and system thinking principles they can use in managing business operations. They map the communication channels in the VSM for their business. And they specify the information that will flow in each channel. They will also determine the measures that
will help their businesses achieve their objectives. Chapters 5 through 11 offer suggestions.

Then the next level of recursion can go through the same self-organizing process. That’s the one-recursion-at-a-time method for gaining the benefits of systems science and system thinking for changing and improving company performance. But companies more confident in system science and system thinking may wish to move faster. These companies can choose to work with more than one level of recursion at a time. They can begin with the corporate VSM and one level of recursion. At the same time elsewhere at other levels of recursion, people can begin learning about and applying system principles and the VSM. Very often, the VSM is first learned and used one or two recursions away from corporate. Lessons learned can then spread wider and higher.

Self-organization, of course, is not a one-time thing. Self-organization is continuous. Systems evolve; and company systems can substantially change over time through internal change, innovation in new products and processes, new ventures, M&A activity, and divestitures. VSM companies become adept at managing for success today in ways that will lead to success over the years ahead.

**SELF-CONTROL**

Systems also have a capability for self-control. Otherwise they could not continue to exist in their environments. The sun shines (an information signal). Rain falls (an information signal). A seed grows. With many replications, and with many other interactions, the forest continues to exist. No control from a higher authority. The forest, naturally and by the principles discovered in system science, controls itself.

The complex, probabilistic system that is a corporation also has a natural capability for self-control. The company wants to continue to exist in its environment. And it wants something more. The company exists for a purpose. The company wants to continue to exist and continue to achieve its purpose. Unlike a forest, the company system does have a top-level authority. The job of this top level authority is to achieve company purpose over time. But how?

The Board of Directors, the CEO, the senior executives, all collectively, with all their knowledge and experience, immediately confront Ashby’s Law. The variety in what needs to be controlled is many orders of magnitude greater that these few people can control. Systems science
and the VSM, which identify the problem, also offer a resolution—throughout the company develop measures of what matters, and enlist the capabilities of people throughout the company as controllers. People doing the task control the task. People running the process control the process. Project members control the project. Managers control their functions.

Feedback from the work itself enables people doing the work to control what’s happening and achieve desired results. An operator at a machine knows the desired output, and by setting control parameters on the machine, monitoring machine sensors, and by visual, sound, and other perceptions controls the performance of operator and machine to produce the desired output. The supervisor of a process assists operators, checks control parameters, and continuously observes what’s happening. Feedback from the work itself enables operators and supervisor to control what’s happening to achieve desired results. A salesperson, through customer contacts and customer actions, continuing appraisal of competition, and awareness of company actions and capabilities can achieve a successful level of sales revenue. At all levels, feedback from the work itself controls performance.

Budgets and “control reports” don’t control performance. Feedback from the work itself, as the work is being done, controls performance. Companies run on real time. That’s why continuous budgets and continuous planning is more useful than budgeting and planning for accounting periods (see chapter 5).

Using the VSM and the system science and cybernetics embedded in the model, decisions are made throughout the company by people who have the requisite variety to make the decisions. The mechanism is not decentralization. The VSM gives us a better way—recursion and information and requisite variety, and self-organization, and self-control as described in this chapter. The design of each viable system model includes the specification of measures needed to coordinate actions and to inform and motivate the achievement of desired results. Information controls performance. Effective information is feedback from the work itself. Sales people get sales and customer feedback, not from reports, but from their customers. People running a process get feedback from measures of process parameters, not from reports. Project feedback informs project members continuously, not periodic reports. The self-controlling business system runs on real time. There are measures of many kinds, as needed for decisions at all levels of recursion.
The VSM and system thinking make system design the number one responsibility of top management at each level of recursion. The responsibility is on-going. Design the system. The VSM is a most useful model for understanding the company as a viable, very complex, purposeful, probabilistic system. Using the model and its system science and cybernetics described in this chapter changes and simplifies the job of top management. Instead of running the company, the job of top management is to continuously design the company to run itself to achieve desired performance.

OVERVIEW: THE ESSENCE OF CHAPTER 1

Chapter 1 describes a number of key concepts from system science essential for effective management in turbulent times. These concepts are used and referred to throughout this book. They are the great simplifiers, fundamentals that make effective management possible in today’s turbulent times. It is important to understand these concepts to get full value from the rest of this book. The key concepts, in the order they appear in this chapter:

1. A business is a viable, very complex, purposeful, probabilistic system. We know all the parts of the system but because the system is probabilistic, exactly how the system will perform is unknowable. However, the system’s probabilistic behavior can be guided to desired performance results using the principles discovered in system science.

2. The VSM includes in company structure information, and the environments the company operates within. Management manages both the inside and now of company operations, and the outside and future for what’s ahead.

3. Cybernetics, a major part of system science, is the science of communication and control in systems. Cybernetics is the science of effective organization, and a part of the system science embedded in the VSM.

4. Variety, in system science is the measure of complexity, and is defined as the possible states of the system. For the viable, very complex, purposeful, probabilistic system that is a corporation or a business, variety becomes numbers incomprehensively huge. Management must deal with the huge variety in operations, and
the very much greater variety in the company’s environments. Management can’t and doesn’t need to comprehend all this variety. But management can comprehend what matters.

The variety in operations can be “attenuated” (reduced) by selecting from all that variety what it is that matters in producing desired performance. And the huge variety in the company’s environments can be attenuated to what matters for achieving company purpose. Attenuating the variety in operations and in the environments still leaves great variety, which can be further reduced by wisely selected measures. For effective control, management variety needs to be amplified to be able to deal with this variety. The key to amplifying the variety in management is to greatly increase the number of people doing the managing.

5. Ashby’s Law states that only variety can absorb variety. Ashby’s law of requisite variety is a fundamental principle of cybernetics. Requisite variety means that to control the variety in operations, the controller must have equivalent variety. And to control variety in the environments that matters to the achievement of company purpose, the controller must have equivalent variety. Requisite variety determines where effective decisions can be made. Within a corporation, requisite variety can be achieved through attenuating the variety in what is controlled as noted in number 4 above and doing this at all levels of recursion for each business unit. To control the reduced variety, the variety in the controller—management—is amplified by the large numbers of decision-makers throughout all levels of recursion.

6. Black Boxes in the VSM are organization units whose internal functions can’t be known by anyone outside the black box. Management outside the black box can know the functions inside the black box only in a very general way. To higher level management, each operating unit is a black box. The higher level lacks the requisite variety to intervene within the black box to fix a problem or develop an opportunity. Problems and opportunities can only be dealt with effectively within the black box.

7. Homeostats are those elements in the system that maintain stability and the normal functioning of the system. When some internal or external action disturbs or disrupts the normal functioning, these homeostats act to restore stability. In the VSM, homeostats are designed into the system. Conventional management seldom has organized homeostats. Disruptions are dealt
with on an ad hoc basis, often by decision-makers lacking requisite variety.

8. Heterostats are those elements in the system that create change, learning, evolution, creativity, improvement, innovation. Corporations do have organized heterostats—R&D, strategic planning, project teams, innovation teams, skunk works. System science and the VSM structures effective heterostats at all levels of recursion.

9. Recursion is one of the most powerful concepts in system science and the VSM. The VSM models the total corporation as a viable, very complex, purposeful, probabilistic system characterized by the principles discovered in system science. The idea of recursion shows us that all other business units in the corporation can also be modeled with the VSM with the same system functions and characteristics.

The Corporate VSM is recursion zero. The first recursion from the corporate VSM is the corporation’s main business groups; typically some number from three to eight. Each of these business groups can also be modeled with the VSM. The second recursion, then, is the businesses in each of these groups, each modeled also with the VSM; and so on through as many recursions as may be appropriate. At the corporate level and at all recursions, all can be modeled with the VSM with the same system functions and characteristics. This structure of recursions gives us new methods for effective management.

10. Self-organization is one of the most important characteristics of systems. The system that is the world’s oceans organizes itself. A salt marsh organizes itself. A company and its business units, each modeled with the VSM, also have the capability to organize themselves using the principles embedded in the VSM.

11. Self-control is another important characteristic of systems. The world’s oceans control themselves. A salt marsh controls itself. And the company and its business units, each modeled with the VSM, also can and do control themselves using the principles embedded in the VSM. Higher-level management, relying on the characteristic and the capability for self-organization and self-control, leads by indirect management as described in the VSM. Indirect management improves control of the present, and motivates the creation of the future.
NOTES