

Study Guide

For

Systems Thinking *Managing Chaos and Complexity*

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Note to the User

I have tried to summarize the main points in this important book in such a way that you may perceive things on the first reading that were not necessarily apparent to me on my first reading. The book is heavy on specialized language and interwoven concepts, so I have given you the "In Addition" section that enumerates terms, lists, and cross-references that may be useful to you. I did not define the terms, but left that for you as part of your learning. In the "Think About It" sections I have provided some prompting questions intended to help you to apply and evaluate what you have read. Substitute your own if these are not meaningful to you.

Depending on your learning style, you may want to read the designs in Part IV first. If you do, I have given you points of emphasis and cross-references to the concepts and figures to which these designs correspond. Or if you read the designs last, you can use them as a review.

For his patience in teaching me and his persistence in writing the book, I thank Jamshid. For the editorial remarks and interpretations I take full responsibility. As I learned from Jamshid, "Understanding comes at the end of the learning process, not at the beginning." My understandings will grow over time, but I hope that by sharing them with you I have helped you to learn more rapidly.

- Susan Leddick
May 18, 2000

Part I: Philosophy

Chapter 1: How the Game is Evolving

Synopsis

Jamshid wrote no introduction to this section. Speculation might suggest that it is to him what Profound Knowledge was to Dr. Deming: the clearest and most fundamental statement of the concepts and insights developed over a lifetime of study and practice.

Five critical components comprise the section:

1. Five forces systematically convert success into failure. In success lie the seeds of failure.
2. While the organization as a whole is becoming more interdependent, the parts increasingly display choice and behave independently. This condition forces a dual paradigm shift.
3. The first paradigm shift is in how we conceptualize an organization. Jamshid traces two historical views and introduces the sociocultural view.
4. The second shift is in how we inquire into systems. Jamshid differentiates, then integrates, analysis and synthesis as modes of thought and methods of inquiry. He shows how the two methods produce qualitatively different understandings.
5. Six distinct "competitive games" emerge from the paradigm shifts, with the most recent being interactive design. (Notice the attribution to Ackoff.)

In addition...

Summary Figures 1.7 and 1.9 on pages 17 and 23 are important organizers.

Sets of concepts to understand

- Five forces that convert success to failure
- Two paradigm shifts
 - Mechanistic, biological, and sociocultural views
 - Analytical and systems approach to inquiry
- Six competitive games resulting from the two-way paradigm shift

Think About It

Why is success "the name of the devil"?

Why is design an appropriate planning method, given the assumptions set forth in this chapter?

Part II: Theory

In his introduction to these three chapters, Jamshid explains that the formal language of systems is needed to “round out” the perspective and language of analytical science, which has become pervasive in our culture. He introduces that language in this section, a language comprised of terms, principles or rules, concepts, and full-blown theories.

Chapter 2: Systems Principles

Synopsis

Five principles acting together define the characteristics of—and assumptions about the behavior of—organizations viewed as sociocultural systems.

1. Openness. The behavior of living systems can be understood only in terms of their context or containing environment. The environment grows more and more difficult to predict despite efforts to do so. Surprisingly, the more controllable a variable is, the less predictable it is. Despite the difficulty of controlling the environment, organizations can influence it, creating a transactional environment. Leadership is about influencing what can't be controlled and appreciating what can't be influenced. Culture is the default values in a social system that allow it to reproduce the same order over and over again.
2. Purposefulness. Choice, which depends on rationality, emotion, and culture, is the primary idea behind this principle. Attempts to understand purpose are attempts to understand why systems behave the way they do. Purposeful systems can change their ends—they can prefer one future over another whether their environment changes or not. (This idea foreshadows a basic working principle of design: when we design, we assume the old system is destroyed, that the environment remains unchanged, and that the new system represents the explicit desires or choices of the designers.)
3. Multidimensionality is the “ability to see complementary relations in opposing tendencies and to create feasible wholes with unfeasible parts.” When faced with “or,” the system thinker finds a new “and” relationship. (In practice, Jamshid sets up a 2x2 matrix to examine the interactions of high and low measures of two apparently contradictory or opposing variables. Then he defines the unique features of each resulting pair—a new name for each cell in the matrix. The difference between the low and high setting is the point at which behavior dramatically changes on that dimension.) *Difference in degree, then, is difference in kind.* Parallel to the idea of multidimensionality is the concept of plurality, the notion that a system can have any one of many

structures, functions, and process and a combination, to boot. No single choice or relationship prevails.

4. Emergent property. This term is synonymous with Type II system properties, or those defined as properties of the whole not deducible from the parts. Examples include success, development, and happiness. Emergent properties are produced by the *interaction*, not the sum of the parts (multiplication, not addition.) Think of chemistry's combinations and mixtures for a simple example. Sodium (Na) and chlorine (Cl) combine to produce common table salt (NaCl), a new compound with unique properties. The parts have been entirely altered in the creation of the new entity. But salt mixed with water simply produces salty water. The parts retain their individual properties. Jamshid explains how the same phenomenon works for properties such as success.

In addition, emergent properties...

- Are reproduced continuously in real-time, and therefore fragile;
 - Can occur at an order of magnitude higher or lower than the initial parts, depending on the compatibility between them (fair players can make a great team);
 - Cannot be measured directly, but only indirectly through their manifestations.
5. Counterintuitiveness. Actions intended to produce one outcome can produce just the opposite. We can all think of a time when a plan or strategy backfired. Classical concepts of cause and effect come into question because of delayed effects, circular dependencies, multiple effects of a single event, and durability or resistance of effects to change. Predicting outcomes, therefore, means modeling the complex and dynamic delays, dependencies, multiple effects, and durability of the set of interacting factors at work. Prediction is, at best, an uncertain science.

On pp. 50-52 Jamshid links counterintuitiveness to chaos theory, especially the four types of attractors that define complex system behavior. Notice that the motivation for this entire chapter on systems principles is to provide designers with theory and language for understanding and describing behavior of *sociocultural* systems.

Jamshid makes several more "observations" on the counterintuitive behavior of sociocultural systems, some of which repeat points made earlier in the chapter. His recap is on p. 55.

In Addition...

Cross-reference the term *iteration* (p. 51) with Part III of the book.

Lists or sets of concepts

- 5 principles
- 3 aspects of choice
- 2 types of properties

Terms to define

- Openness
- Purposefulness
- Multidimensionality
- Emergent property
- Counterintuitiveness
- Influence vs. control
- Transactional environment
- Leadership
- Information vs. knowledge vs. understanding
- Culture
- Purposeful system vs. state-maintaining and goal-seeking
- Type I vs. Type II properties
- Plurality

Think About It

How does successfully “playing the game” change the game? What might this theorem mean to your organization?

After reading this chapter, why do you think there are so many conflicting reports of research findings? What’s to be done?

Why study and plan if you can’t predict?

Chapter 3: Systems Dimensions

Synopsis

One of the most sweeping concepts in Jamshid's work is the five systems dimensions. He intends them to be "comprehensive...describing the organization in its totality." After introducing them here, he uses them as a diagnostic framework in Chapter 6 (Defining the Problem) and as a solution framework in Chapter 7 (Designing a Solution). He states his main purpose: "to explore the practical implications of these five dimensions in designing business processes" (p. 58.) Thus the five dimensions manifest themselves in five processes, which are in turn comprehensive of all the processes an organization requires.

Jamshid differentiates between *throughput* and *organizational* processes. Throughput processes depend on technology; organizational processes depend on assumptions and the dominant culture in the organization. Yet at the same time, organizational processes create the culture. They are rarely purposefully designed and are often the result of default decisions. Incompatibility of organizational processes often renders technological or throughput process changes ineffective.

1. Throughput processes are for generating and distributing *wealth*. Designing a throughput process means addressing four elements:
 - A model of the process (Figure 3.3),
 - Critical properties,
 - Measurement and diagnostic system, and
 - Read-only memory (Figure 3.9).Target costing and variable budgeting add accountability to design. Target cost is established by the market; variable budgets treat every active process element (including the executive office) as a performance center.
2. Membership processes are the roles people play in a sociocultural system and the degree to which people feel able to contribute, to be important, to be powerful. Alienation, incompetence, anxiety, frustration—all signal problems in the membership process or *beauty* dimension. Note that "The purpose of an organization...is to serve the purposes of its members while serving the purposes of its containing whole" (p. 67). The exchange system sets the means by which both the individual and the organization gain from membership. The threat system prohibits behavior destructive to the system. The ultimate threat is banishment.
3. Conflict management processes are based on the *values* dimension. Four kinds of relationships can exist with regard to people's degree of agreement on ends and means: *conflict, cooperation, competition, and coalition*. There are four ways to address conflict:
 - Solve (win/lose),
 - Resolve (compromise),

- Absolve (benign neglect), and
- Dissolve (change or remove the environmental conditions through redesign).

Note that obstruction is easier than progress (p. 69). Searching for a higher-level objective or end shared by two people or groups in conflict can change conflict to competition.

4. Decision systems are based on the *power* dimension. A sociocultural system must be governed in such a way that individuals have choice and the collective has power to accomplish its ends. Counterintuitively, more choice demands more leadership. Effective leadership discloses decision criteria, allowing power to be duplicated rather than shared. When power is duplicated, centralization and decentralization can happen simultaneously. The circular organization (Figure 3.8) is the structural form that allows for maximum participation, choice, coordination (horizontal or peer interaction) and integration (vertical interactions).

Decision criteria are rules for decision-making. They may be policies (“why”) or procedures (“how”). Every organizational unit should make its own procedures, with four attributes:

- Degrees of freedom,
- Consistency,
- Explicitness, and
- Consensus.

Leadership strategies for developing consensus include synthesizing positions, proposing experiments, and articulating what would prove opposing groups wrong.

5. Learning and control systems are based on the *truth* dimension. In order to learn, people have to detect a mismatch between predicted and actual outcomes. Diagnosing why the mismatch occurred and prescribing a different course of action define learning. A formal record of expected outcomes must be maintained as reference. When mismatches occur, look for these causes:

- Wrong information or data,
- Wrong decision,
- Flawed implementation, or
- Changed environment or context.

A measurement system needs to provide early warning signals to decision-makers. Used right, control is not a service but a *learning* function. A social calculus seeks to integrate or make compatible people at different levels in the organization, people at the same level, and people at different times. Jamshid names these compatibilities vertical, horizontal, and temporal. He has developed elaborate schemes of incentives to achieve compatibility in various designs.

In Addition...

- Important Figures are 3.1 (p. 58) and 3.9 (p. 76).
- Cross reference Figure 3.1 with Figures 1.9 (p. 23), 6.1 (p. 120), and 7.1 (p. 131).
- Lists of concepts
 - 5 system dimensions
 - 4 forms of interaction
 - 4 ways to address conflict
 - 4 things to look for when plans go wrong
- Terms
 - Wealth
 - Truth
 - Beauty
 - Values
 - Power
 - Exchange and threat systems
 - Conflict, cooperation, competition, coalition
 - Duplication of power
 - Decision criteria
 - Policy vs. procedure
 - Social calculus
 - Learning
 - Control

Think About It

Why is compromise troublesome?

Why are learning and control addressed together? How do you think Jamshid would define "learning organization"?

Chapter 4: Sociocultural Model

Synopsis

Jamshid goes beyond the truism that all the parts of a system are related to explore the “assumptions regarding the nature of the relationship” (p. 83). Relationships are structure. Sociocultural systems are held together (“bonded”) by information. Communication flows maintain the bonds among individuals and between the organization and its members.

Specifically, culture and social learning are vehicles by which information bonds people in organizations. People create their cultures through transparent assumptions. Cultures shape people by acting as decision defaults. Yet people can transform cultures by questioning existing assumptions and actively choosing others. *Social learning* is the process of changing those assumptions. Fear of rejection and tendency toward conformity obstruct change.

Jamshid shows that many views of *development* are limited to few dimensions. He argues that purposeful systems as a theoretical construct allow simultaneously for multiple structures, functions, and processes.

When explaining “development,” Jamshid alternates between the collective and individual perspectives. To be well-developed, an organization must be capable of both high differentiation and high integration at the same time. Differentiation brings flexibility and excitement while integration assures a feasible whole whose different parts are complementary and effective. A well-developed individual has both desire (motivation) and ability (competence). Neither is sufficient to define or produce the emergent property development, but both interact to do so. Jamshid concludes that developed organizations also have desire and ability.

How, then, should an organization be organized to challenge the assumptions on which it is based and to produce high degrees of development for itself and its members? How can the parts of an organization be independent and self-controlling at the same time they are responsible to a collective whole? By a multidimensional *modular design*, Jamshid replies. The backbone of the modular design is the triplet *input* (technology), *output* (products), and *environments* (markets). See Figure 4.5. Each module is defined by unique functions and the relationships among modules are explicitly defined. In other words, an input module is qualitatively different from the other two and has a pre-defined relationship with each of them. Jamshid describes each type of module and suggests design principles.

In Addition...

Cross-reference the sociocultural model with the first paradigm shift, Chapter 1; cross-reference plurality (p. 88) with pp. 42-45.

Lists to note

- 3 dimensions of a modular design

Terms to define

- Sociocultural vs. mechanical and biological
- Social learning
- First- and second-order learning
- Development
- Differentiation
- Integration
- Desire
- Ability
- Internal market economy
- Interactive planning

Think About It

Why is the concept of development so central?

Why are differentiation and integration complementary and not opposites? Relate this concept to fragmentation of any kind in your organization.

Part III: Methodology

Jamshid has long criticized his colleagues in systems science for the failure to develop a comprehensive methodology that extends beyond a few field techniques. In his view, the methodology must contain a means to define problems in any kind of organization in any context as well as a means to develop unique solutions that will solve the interacting set of problems at one go. In Chapter 5 he defines the methodology. In Chapter 6 he shows how to use it to define problems. In Chapter 7 he demonstrates how to design solutions.

Chapter 5: An Operational Definition

Synopsis

Systems methodology is defined as “a design approach dealing iteratively with structure, function, and process” within a specific context (p. 110).

Jamshid associates analysis and the classical school of management with *structure*, synthesis and the neoclassical school with *function*, and behavioral science and TQM with *process*. He emphasizes the shortcomings of traditional causality as a means of understanding interdependent variables.

Both inquiry for understanding and designing a solution are iterative or cyclic. Each iteration produces greater clarity. Designers must be able to separate problem formulation from solution generation.

In Addition...

- Note Figure 5.5 (p. 114.)
- Terms to define
 - Iteration
 - Structure
 - Function
 - Process

Think About It

How is the Persian version of the parable of the blind man and the elephant different from the Western version? What difference does the difference make?

Why separate problem definition from problem solution?

Chapter 6: Defining the Problem

Synopsis

The nature of problems is to fuse into interacting sets or systems of problems. Ackoff called such sets "messes." To begin with, the problems are unstructured and misunderstood "Formulating the mess" requires

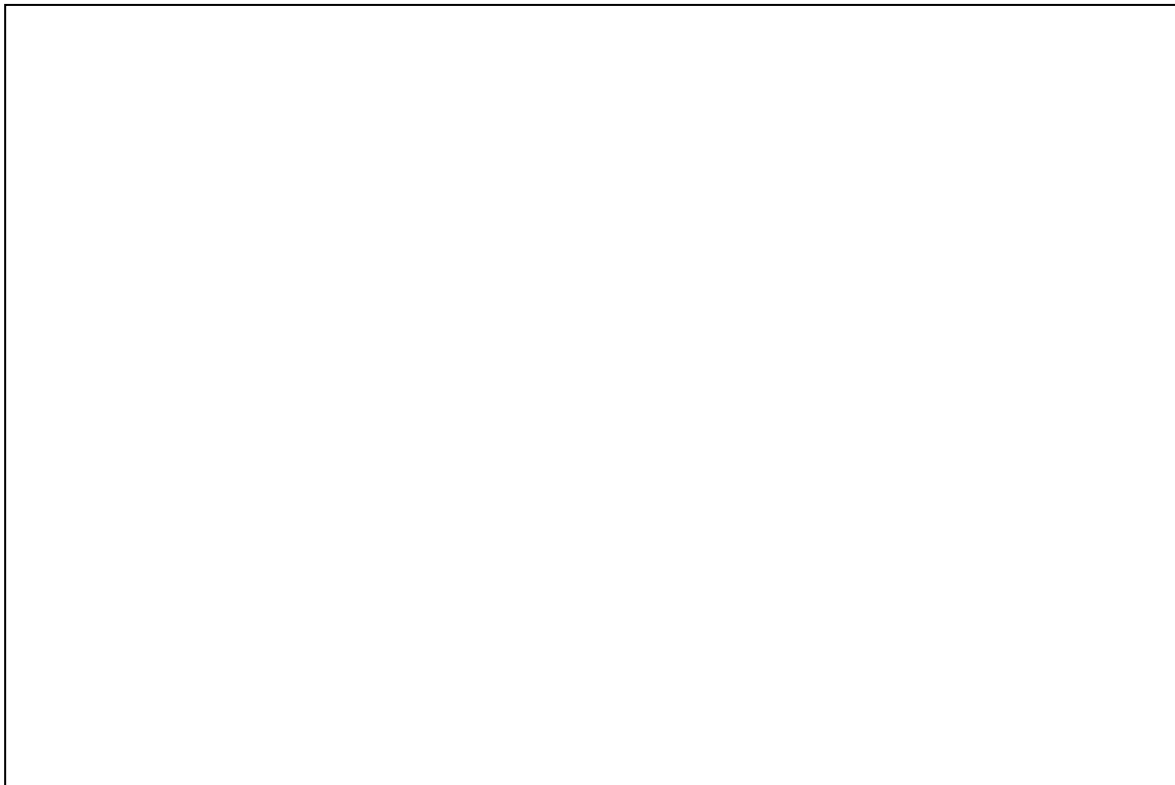
1. a *search* for information, knowledge, and understanding about the system (internal) and its environment (external);
2. *mapping* or grouping observations and identifying emergent themes;
3. *telling the story* in such a way that it warns system leaders and mobilizes them to replace an undesirable future with the one they prefer.

Searching involves

- *System analysis* or description without judgment (Table 6.1 suggests categories of relevant information);
- *Obstruction analysis* or identifying blocks in the five systems dimensions (see Chapter 3 and Table 6.2); and
- *System dynamics* or understanding interactions of critical variables inside the system, outside it, and across time (see Table 6.3).

Mapping results in diagrams that simplify and elucidate the relationships among key variables.

Telling the story should emphasize early warning (not prediction), the role of success, and hope for the future.



Think About It

How is Jamshid's method for problem identification different from or unique compared to other methods you may know? What do you think of it?

If you apply the method to your own situation, what insight do you gain?

Chapter 7: Designing a Solution

Synopsis

Formulating the mess helps designers face the right problem. Now comes the work of solving it. Design assumes the old system was destroyed overnight but the environment remains unchanged. Idealized design (the best design the creators can produce, the next generation of their system, not a perfect or ideal solution) is subject to three constraints:

1. technological feasibility,
2. operational viability,
3. learning and adaptation.

Figure 7.1 is a schematic outline of the design process. To enumerate design specifications, begin with an appreciation for stakeholder expectations and an understanding of the organization's competitive environment.

To define the purpose, see whether the organization's business is defined by product, market, or technology. Then design to integrate the three (see Chapter 4). Build strategic intent on core competency, the context-free knowledge available for application to anyone in the organization. Set measures of success, and identify core values.

To define functions, clarify which problems are solved by which products for which customers.

To define structure, establish a modular design that defines complementary relationships among relatively autonomous units. All units are performance centers.

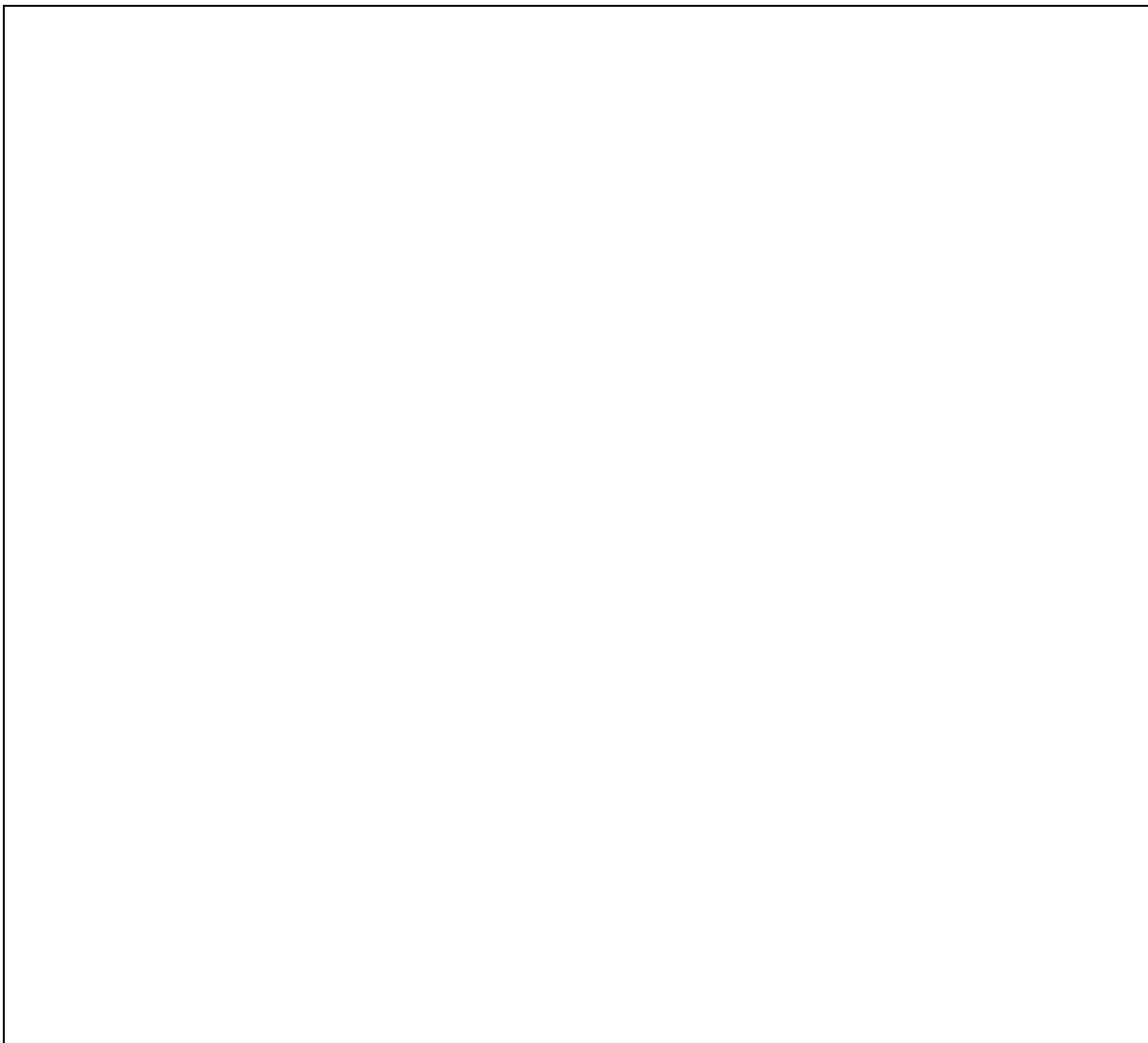
Design processes according to the guidelines established in Chapter 4.

Jamshid provides an elaborate and comprehensive scheme of performance criteria and performance measures. See Table 7.1 on p. 131 for the summary. Notice that the columns contain the four variables that define the organization as a whole while the rows contain the three key management and leadership processes. *The way you keep score defines the game.*

After the design is conceived, it must be brought to life or realized. Implementation—like inquiry and design—is iterative, taking place in successive approximations of the idealized design. Implementation is a matter of identifying, classifying, and removing constraints of three types:

1. Type I – those that cannot be removed under existing conditions, necessitating successive approximations;
2. Type II – those whose removal requires extensive preparation, necessitating preparatory activities;
3. Type III – those removable now if the designers wish, necessitating immediate decisions and changes.

The most difficult transformations are those requiring cultural change of the assumptions on which the current order is based. This is the “second order machine.” The successes of the past are embedded into experience and seem to defy the changes implied in the design. Leaders must help people to separate out only those assumptions that are dysfunctional and to retain the others.



Think About It

What if “users of services had the power of the money and controlled payment to the service provider” inside your organization?

If your organization is subsidized or subject to third-party payers, what are some implications of the above question?

Do you really think culture can be changed in organizations? Why?

Part IV: Practice (Examples)

Synopsis

Each of the five designs in this section has a different emphasis. What we learn from that variety is that design produces unique solutions to the sets of problems presented in each situation. Common elements are used, but no design is a copy of any other.

1. Oneida emphasizes critical processes for organizing, producing, and planning. Notice that the five “systems” in this design correspond to the five sociocultural system dimensions (see Figure 1.9 on p. 23, Figure 3.1 on p. 58, and the corresponding text; see also all of Chapter 3). Jamshid has done a lot of work with developing nations, and he has said that it is his favorite context for working. The Oneida design demonstrates his ability to appreciate and integrate the pre-existing culture into the eventual design.
2. Butterworth emphasizes architecture and next-generation solutions. Notice what’s included in each “grouping” or platform and how they interact. Architecture is structure; structure is the people, their roles, and how they interact. (Cross-reference to pp. 139-142.)
3. Marriott emphasizes architecture, especially the redesign of the product and marketing processes. The printed text is an excerpt from the complete design (as are the others in Part IV), but the Marriott design as printed is a compact example of the entire process and a scaled-down model of what might be presented to a client. Compare the bold headers to Figure 7.1, p. 131. Appreciate the insight required to produce the bulleted lists on p. 229. The process of inquiry used to generate those insights appears in schematic form on p. 120 as Figure 6.1.
4. Commonwealth Energy emphasizes dissolving the mess and creating the future expressly desired by all the people involved. Notice how much attention is given to stakeholder expectations and the environment. This design is a good example of how interactive design differs from traditional predict-and-prepare strategic planning.

5. Carrier emphasizes use and development of a core technology (see p. 269). Notice the implications for staff development and especially how core knowledge must be known to and accessible to everyone in the organization. Notice the design of the regional units, how much autonomy they have, and the role clarity provided by the architecture. This design also illustrates value-chain management on pp. 280-281.

General Questions for Conversation and Reflection

1. What systems are crying for redesign and why?
2. How would you explain the difference between strategic planning and interactive design? How could the two work together?
3. What do you make of current social trends given the framework of the sociocultural model?
4. If you were to redesign your work unit, what would you be careful to do? Whom would you involve and why?
5. What were some of the most appealing concepts in this book? Why?
6. What were some of the most unsettling concepts in it? Why?
7. What did you wish for that wasn't in this book?