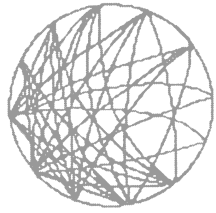
CHAPTER 12



THEORY

A System Science of Virtual Teams

For the past 20 years, we've been researching and developing a science of networked organizations. Here we summarize the underlying theory of this science.

"General systems" provides the theoretical infrastructure for a network science. From that well-established base, particularly in the social sciences, we have developed a simple model with four dimensions: *people, purpose, links,* and *time* (review Figure 6.1).

With theory, the principles, practice, and place that a virtual team uses all can be threaded with consistency. Instead of virtual work being haphazard and sloppy, such an approach gives integrity and solidity to what can appear impromptu and random. The team structures its information and consciously manipulates it within a context that the team itself creates.

The four dimensions of the network model plug into the bedrock of general patterns of organization.

The Periodic Table

What is the basic data that a virtual team must acquire about itself? To account for all the essential characteristics that comprise virtual organizations, we need to go down a level, expanding each dimension into three elements. We array these 12 elements in the familiar systems model of inputs, processes, and outputs (Figure 12.1). This generates a "periodic table" of organizational elements, providing the conceptual infrastructure for practical approaches to creating and managing virtual groups on any scale.

This taxonomy (a theory-based framework of categories) provides the basic architecture for our four-wall design of an online virtual team room (Chapter 11, "Navigate"). We've talked about the elements in earlier chapters, and we'll review them here.

Purpose

- Cooperative goals *Do*
- Interdependent tasks *Doing*
- Concrete results *Done*

In Chapter 7, "Purpose," we point out why a particular team works together. Purpose implies some minimal level of interdependence among the people involved. As we've said before, virtual teams are far more

Figure 12.1 Periodic Table of Organizational Elements

	Inputs	Processes	Outputs
Purpose	Goals	Tasks	Results
People	Members	Leadership	Levels
Links	Media	Interactions	Relationships
Time	Calendar	Projects	Life Cycles

reliant on their purposes than are face-to-face ones. Because they operate outside the bounds of traditional organizational life without bureaucratic rules and regulations to guide them, virtual teams require a common purpose to stay in tune.

Cooperative goals are what purpose looks like at the beginning of any successful teaming process. This is why so many books about teams begin by focusing on goals. A set of *interdependent tasks,* the signature feature of teams, connects desires at the beginning with outcomes at the end. When a team finishes, it has its *concrete results,* the final expression of its purpose, the measurable outputs of joint effort. These three elements—cooperative goals, interdependent tasks, and concrete results—enable virtual teams to stay focused and be productive.

People

- Independent members — *Parts*
- Shared leadership — *Parts as wholes*
- Integrated levels — *Wholes*

In Chapter 8, "People," we go into detail about the special challenges facing virtual team members. *Independent members,* the people and groups who make up the team, must act with a significant degree of autonomy and self-reliance. While virtual team leadership tends to be informal, it also is pervasive. The diversity of technical and management expertise required means that members share leadership at different points in the process. In cross-boundary work, *shared leadership* is the norm.

A team is a complex human system with at minimum two levels of organization—the level of the members and the level of the group as a whole. Teams also are parts of larger systems, growing out of and embedded in organizations. To be successful, virtual teams must *integrate levels* both internally (subteams and members) and externally (peers and supergroups).

Links

- Multiple media — *Channels*
- Boundary-crossing interactions — *Communicating*
- Trusting relationships — *Bonds*

To say it again, what gives *virtual* teams such distinction as a new form of organization is their *links* (see Chapter 9). Relatively suddenly, multiple, constantly enhanced modes of communication are widely available. Links provide access to vast amounts of information and unprecedented possibilities for interaction. Twenty years ago, we chose the term *links* for this defining feature of virtual teams because it bridges three key aspects of communication.

First, people need the actual physical connections—wires, phones, computers, and the like—that provide the potential for communication; they are the prerequisite for interaction. *Multiple media* are moving virtual teams from the extraordinary to the ordinary as the technology wave of Information Age change reaches the mainstream. Connections make *boundary-crossing interactions* possible. The back-and-forth communication among people—the activities and behaviors—constitutes the actual process of work. It is here at the boundaries of interaction that virtual teams are truly different.

Through interactions near and far, people develop *trusting relationships,* the invisible bonds (and baffles) of life (see Chapter 4, "Trust"). People's patterns of behavior mark the outlines of relationships that persist and feed back into subsequent interactions. As important as positive relationships and high trust are in all teams, they are even more important in virtual ones. The lack of daily face-to-face time, offering opportunities to quickly clear things up, can heighten misunderstandings. For many distributed teams, trust has to substitute for hierarchical and bureaucratic controls. Virtual teams with high trust return this valuable social asset to their sponsoring organizations for use in future opportunities to cooperate.

Times

- Coordinate calendars — *Dates*
- Track projects — *Durations*
- Follow life cycles — *Phases*

Collaboration requires parallel work and mutually agreed-upon dates. In virtual practice, this means a need to *coordinate calendars* for having conversations and executing work. Virtual teams naturally *track projects*

as they carry out their activities largely in cyberspace, which ensures collaborative feedback and learning. The most successful virtual teams consciously *follow life cycles* of team behavior. Forming, storming, norming, and performing all require extra effort, higher awareness, and greater participation by group members to manage the whole. Each team has its unique clock (see Chapter 6, "Time").

Practical Principles

The ability to adapt to the rapidly changing environment of virtual work is enormously enhanced by the use of theory. Experience meshed with theory offers principles for a coherent, testable, scientific approach to this new world of work.

You probably already practice many of these principles. By simply upgrading your knowledge and translating your experience into a concise language, you will enhance your own and your team's capabilities immediately. If you work with the principles long enough, you will gain the keys to better, faster, smarter virtual work.

These principles are not sacred, but since publication of our first book, *Networking* (1982), they have been reviewed, used, and practiced extensively by people in business, nonprofit, government, religions, and grassroots sectors. Together they constitute a tested theory of virtual work and distributed organization.

The great advantage of recognizing general principles is in their application. Principles allow you to take knowledge from one situation and transfer it to another.

Pattern Language for Virtual Teams

The word *network* is so common that some Internet search engines eliminate it from any search. The network idea is a general concept, like *system,* and applies to nearly everything: molecules, neurons, waterways, transportation, television stations, and computers.

Truly fundamental patterns of thinking reflect an underlying configuration for understanding the world around us—a "pattern language."[1] This shared language simplifies complexity. One such complexity-busting pattern is the systems principle of hierarchy.

This is hierarchy in the big picture, different from its conventional meaning in a social context. It's about organization generally—how the right design gives both cooperative and competitive advantage.

Nobel Prize–winning economist Herbert Simon tells the most famous parable of systems theory, a story of two Swiss watchmakers. Simon calls them Tempus (whom we call Linda), meaning "smooth time," and Hora (we call him Sam), meaning "serial time." Our adaptation of this story shows the power of hierarchy of the scientific sort. Simon names this pattern the "architecture of complexity."

The Innovators

Two young technologists, feeling the limits of their then-crude craft, begin to develop breakthrough products for their market. Soon, both develop splendid prototypes of awesome versatility and complexity. Indeed, Sam Serial, the prized protégé of the traditional masters in the field, finishes his model noticeably sooner than Linda Levels, the challenger of orthodoxy. Clearly, Sam has the edge in what could be a very big market. The business press eagerly look forward to the unfolding story.

News of the revolutionary demos spreads, and people start to call for information, interrupting the young entrepreneurs with questions. Within a few months, Linda is delivering product to delighted customers, while Sam struggles to complete the first production copy as orders pile up. Both decide to hire apprentices and to train new workers in their respective methodologies to meet the demand. Linda is able to train new people quickly and boost production enormously, while Sam sinks further into minutiae, as training crawls and products only occasionally appear.

After Sam Serial's bankruptcy, observers investigate to learn what they can from this epic story of success and failure. The key difference, they discover, is in how each entrepreneur designs the work of constructing the product—the organizational advantage.

Sam simply extends the old way of fitting pieces together into a whole by adding many more pieces. The effect is somewhat like a rich mosaic, a thousand parts put together intricately—a beautiful but fragile assembly.

Linda, however, borrows a method from nature and constructs a series of subassemblies, 10 pieces to a group, intermediate components of the product. The extra steps spent putting subassemblies together account for the initially longer time needed to build the prototype. Nevertheless, this integrated approach produces a design both elegant and resilient.

When assembly is interrupted, the partially completed unit is put down, and naturally it falls *a-part.* It *dis-assembles.* What works well in isolation does not always work well in the real world that is full of interruptions—otherwise known as *change.* For each thousand steps of process, Sam risks hundreds of steps at every interruption, while Linda loses only an average of five steps when she resumes the assembly process. Linda has designed stable structures between the elementary pieces and the product as a whole, specific points in the process that hold together without the next step.

The power of Linda's method of chunks within chunks becomes clear as volume increases and markets change. Linda Levels, with a probability of just one interruption per 100 steps, gains a 4,000-to-1 advantage over Sam Serial.

Complexity

Systems within systems within systems. Why is this design principle so universal and so powerful?

Simon says that complexity evolves much more rapidly from simplicity if there are "stable intermediate structures," subsystems sturdy enough not to pull apart. Hierarchies predominate in nature, he says, because "hierarchies are the ones that have the time to evolve."

> *This is a profound, basic, natural design principle: a hierarchy of levels.*

In the scientific sense of levels, hierarchy is basic to astronomy: planets and satellites in solar systems in galaxies in galaxy clusters that are part of superclusters and even greater amalgamations. Hierarchy brings

us molecules, atoms, particles, and quarks in physics. Biology has cells, tissues, organs, organisms, ecologies, and environments. Pennies make up dimes that make up dollars in the U.S. currency system. Time comes in subassemblies of minutes, hours, days, weeks, months, and years. Libraries shelve books according to the Dewey decimal system version of this theme. We even build our community communications systems this way with trunks, feeders, and drop lines to houses.

Levels within levels—hierarchies—permeate every aspect of the core technology of the Information Age. Computer hardware is built in levels—from binary switches to chips to logic boards to computers to systems with peripherals. We design software in levels of complexity from machine languages to assemblers to operating systems to applications; we structure files hierarchically in folders; and we connect PCs in local-area networks plugged into wide-area networks linked to virtual private networks on the global Internet.

We use the hierarchy principle every time we analyze a problem or break something complex into smaller parts. We also use it to put things together, for synthesis, to create new wholes out of parts. When we outline our thinking, we use hierarchy.

It is no surprise, then, that the same structure of levels permeates organizations. As individuals, we are parts of families who make up communities and neighborhoods, which in turn are included in local, state, and national jurisdictions. All of these are points of natural cleavage—stable intermediate structures, as Simon says—in the hierarchy of society.

All networks and virtual teams are hierarchical in the scientific sense. Even the simplest ones are made up of interacting parts that are themselves complex—people or groups.

Interruption is a metaphor for change in the story of our inventors, Linda Levels and Sam Serial. The need to organize in stable clusters, modules, and levels increases as the pace of interruption picks up. Sub-

assemblies—distinct components that can stand on their own—become more necessary, while rigid control structures become liabilities under the unrelenting push of ever increasing change.

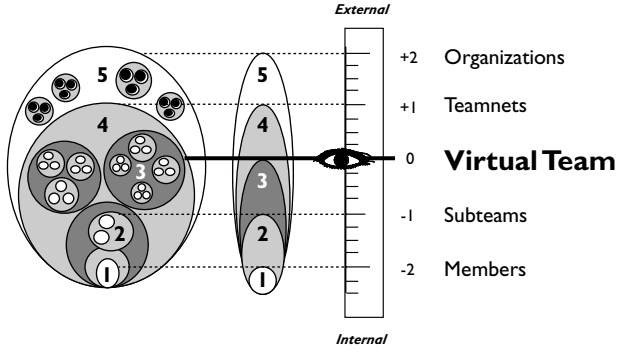
Networks do not throw out the baby with the bath water. They directly incorporate the powerful principle of hierarchy in its timeless sense—the *force behind stable structures*—into the organizational form of networks, a key legacy of the agricultural era of hierarchy.

Hierarchy Ruler

To get a grip on size and scope, apply the "hierarchy ruler" (Figure 12.2), which is one of the most useful mental tools you can employ. On the hierarchy ruler, the anchor is in the middle instead of at one end. Set a point of reference and then look up, down, and across. Each boundary offers an opportunity for multiple perspectives, like that of Janus, the ancient Roman deity who could simultaneously see both inside and outside the walled city from his palace portal.

This mental ruler is a portable, general-purpose tool that can measure complexity in many kinds of things. Its anchor—its point of reference—is a movable one. Indeed, to tap this ruler's power, you *must* move the reference point.

Figure 12.2 Hierarchy Ruler



Place it at different boundaries to assess situations from other points of view. This is a critical cross-boundary networking skill that many people already use well intuitively.

The hierarchy ruler is a powerful tool for resolving conflict.

The corporate boundary is a common point of reference. From the CEO view, the whole organization is your responsibility. From that boundary, you can see both the internal complexities (strategies, budgets, politics, love affairs) and the external ones (competitors, markets, global upheaval). While anchored at the reference point, do the following:

- *Look up.* Externally, ask what significant relationships the company engages—strategic alliances, associations, and coalitions; further out, see the enterprise in the context of whole industries and markets.
- *Look across.* At your level of organization, survey other enterprises, your peers as competitors, collaborators, customers, and vendors; see yourself as a center and view others from core to peripheral relationships.
- *Look down.* Internally, look for the major components, the departments or divisions that tell the broad story of what the enterprise does. Each internal division itself may be made up of groups within groups within groups.

Now move the reference point from the corporate boundary down to your own organization and drop it again to your team, then perhaps yet again to subgroups within the team. Or go up from the enterprise to alliances, coalitions, markets, industries and regions—ever wider circles of associations.

Rule of Two

Wholes and parts are gifts from the universe. They make it possible to simplify the complex.

The network itself embodies this valuable mental tool of levels within levels, a whole composed of people and small groups that are themselves complex.

While whole-part pattern recognition enables a group to better cope with complexity, too much of a good thing will eventually lead again to information overload and breakdown. Too much focus on ever smaller parts leads to deadly, time-consuming micromanagement and planning inefficiency. Similarly, the meaning of myriad wholes that a team comprises can get lost in the global ever-after, in which boundaries abound.

In our experience, the hierarchy ruler works best when you observe the Rule of Two. This means that from a given point of reference, two levels up and two levels down usually provide about the right measure of scope and detail. The trick, of course, is to set points of reference at the most relevant levels of organization—those that reflect relatively stable structures and have internal coherence.

This prospective practical rule of thinking is akin to the experimentally established observation of the Rule of Seven—people can easily keep about seven categories (e.g., numbers, details, points, names) in mind at once.

Systems

Systems theory permeates advanced management techniques. When W. Edwards Deming, one of the founders of the quality movement, turns to science, he does not borrow from the traditional reductionism of Frederick Winslow Taylor. Rather, he views science holistically, as do other great first-generation systems scientists like Herbert Simon and Kenneth Boulding. Deming's business systems model is very straightforward:

Every value-producing organization receives inputs from suppliers and provides outputs to customers.

Networks are systems, pure and simple. Anywhere a systems concept will work, so will a network concept. Indeed, for many systems, particularly social systems, networks are an easier sell.

In the social world, people do not much love the word *system.* It's easy—and often justified—to hate "the system." Some people hate it so much that they are blind to their aversion.

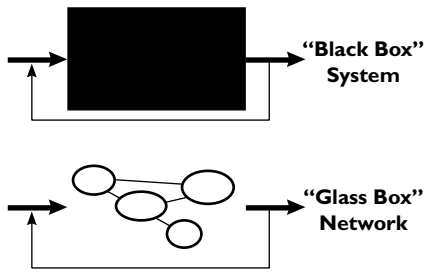
Little wonder. Most traditional systems are black boxes. Think of the tax system or the international monetary system or even the municipal garbage system. Most systems portray themselves as beyond the comprehension and control of ordinary mortals. Traditional systems science is much the same. It offers an obfuscating self-portrait of systems as black boxes, unfortunately too complicated for just anyone to understand.

With networks, you take the wraps off systems. Instead of black-box systems, you see "glass box" networks (Figure 12.3). The outer boundary of the network whole is transparent. See inside to the parts (the nodes) and to the relationships (the links) among the parts. The more clearly you lay out the network-system elements, the easier it is to understand.

Synergy

"The whole is more than the sum of its parts." This systems principle is so popular that it's a cliché. In networks, purpose is the "more than" that defines the whole, or synergy. Together, synergy is possible; in isolation, it is not.

Figure 12.3 "Glass Box" Network



To function, your system—no matter how minimal—has to have some synergy or purpose.

Purpose relates very practically to how people become legitimized in networks through contribution to the shared purpose. Develop purpose as a resource for your team, just as people develop procedures and policies using law as a resource. Encourage your members to participate in planning and decision making to internalize the purpose for themselves. Externalize the purpose through explicit plans, information access, and by creating symbols—logos, nicknames, acronyms. Instead of controlling one another through one-way orders or endlessly detailed policies, boundary-crossing virtual team members exercise control through their shared process—what we represent in the four-wall virtual team room.

Holons

Each of us is a *whole* person who plays a *part* in families, businesses, and communities. Arthur Koestler, author and systems thinker, coined the word *holon* to stand for this whole/part characteristic of everything.[2] And, as we saw in our parable of the innovators earlier in this chapter, complex boundary-crossing teams *are* systems of systems within systems. Every team is a hierarchy of wholes and parts. Complex team members are themselves systems of systems. The systems principles of segmentation and inclusion apply every time a group splits up into task teams or an alliance jells.

Nothing in groups is as complicated as leadership. One way to simplify complex wholes is to grasp a part that represents the rest. In the search for simple ways to "grasp a group," leaders come in handy. Leaders are people who stand for a group. All organizations have leaders, even self-directed groups, where leadership is assumed from within rather than appointed from without. Networks are rife with leaders.

Relationships

Relationships are elusive "things." For some people, relationships are real; for others, they are not. Some people literally cannot see relationships,

even indirectly. These people do well in organizations with rules to govern behavior. They don't fare well in virtual teams and networks, where relationships are at reality's core.

There are so many relationships involved in life and so many different kinds of them everywhere you look. To simplify this vast interconnected mess, traditional organizations have many one-way signs. Hierarchies and bureaucracies take an extremely limited approach to how parts interconnect. Generally speaking, orders and information flow in a minimal number of formal channels. Information flows up and commands flow down. This traffic pattern gives rise to the walls, stovepipes, silos, and other hard-to-penetrate boundaries in organizations.

By contrast, in networks, connections are many rather than few. Information and influence flow both up and down the levels through links, as well as horizontally within levels. What is the situation with your boundary-crossing team? Do information and influence flow along a two-way highway, or are people stopped for going against the traffic?

Space-Time

The underlying framework for virtual time comes from physics and Albert Einstein's famous formulation of space and time as aspects of the same reality. While these dimensions seem so different in the physical world, their interrelationship is much more obvious in the cyber world.

Physical space is concrete and hard, whereas time is ephemeral. Cyberspace is more like time, largely conceptual and soft, albeit still rooted in physical realities of binary switching electronics. In cyber-space-time, more space (memory) generally means less processing time, and more bandwidth space means faster connections and less transmission time.

When place is virtual, time spent with other people is either same-time or asynchronous. On a practical level, it is the cybertime dimension that is most intransigent in the new world of work. Global teams are still bound by the revolution of the earth in 24-hour cycles and natural human sleep patterns. Synchronous time shrinks in global work requiring a correspondent increase in asynchronous capabilities. So we

create collective online places that accrete information and change over time.

Process

The generic concept of process derives from a key pattern found in physical, biological, and social systems. The fabled S curve, the logistic growth curve, that we use to represent the change process (see Figure 6.2), appears in the original paper that Ludwig von Bertalanffy wrote establishing the field of general systems.[3] It was his first example of an "isomorphy," a general principle that holds across scientific disciplines. An isomorphy crosses boundaries.

Well understood in a wide variety of scientific disciplines, the S curve offers accumulated knowledge, available to those who want to deepen their understanding of process. Look to the points of turbulence in the "Stressed S" process and use them to your advantage.

Smart Teams

Smart virtual teams share ideas freely and creatively. People think through what they are doing. Brainstorming is one obvious way that a team thinks; planning is another. Every diagram a team makes, every memo written, agenda proposed, and idea exchanged—all of the team's shared interactions—naturally combine into mental (cognitive) models. As people share their mental models and test them in the team's environment, they collectively think up better ones. The better the shared understanding, the stronger the model. Better group models equal greater group intelligence.

All teams share mental models. In most situations, these models are fragmentary and unexpressed. In the conventional, well-structured, colocated team with its ever present boss and proverbial watercooler for informal interaction, it's all but unnecessary to develop a shared mental model. Lacking the traditional cues, virtual teams, by contrast, need new ones to stay aligned.

Virtual teams like those at Sun that follow clear processes, supported by technology that facilitates and captures their work as it unfolds, naturally develop ideas faster. They are smarter.

Virtual teams that create and display their mental models are smarter.

Abstraction is sometimes difficult for people who prefer the concrete. Most of us feel comfortable with knock-on-wood, hard reality—the "I can see it, feel it, taste it" satisfaction of the material. Unfortunately, these signs of life are in short supply for virtual teams. The faster, more global, and more complex Internet Age demands greater abstraction. The trick is to learn how to use abstraction to advantage by applying it to your own situation.

In this way, abstraction increases your team's intelligence and capacity to produce concrete results.