The bestselling classic on learning organizations—"the organization form of the '90s."
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In the long run, the only sustainable source of competitive advantage is your organization's ability to learn faster than its competition.

Founder and Director of the Center for Organizational Learning at MIT's Sloan School of Management, which boasts such members as Intel, Ford, Herman Miller, and Harley Davidson, author Peter M. Senge has found a means of creating a "learning organization." In THE FIFTH DISCIPLINE, he draws the blueprints for an organization where people expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. THE FIFTH DISCIPLINE fuses these features into a coherent body of theory and practice, making the whole of an organization more effective than the sum of its parts.

Company after company, from Intel to AT&T to Procter & Gamble to Coopers and Lybrand, have adopted the disciplines of the learning organization to rid themselves of the learning "disabilities"

THE FIFTH DISCIPLINE

THE ART AND PRACTICE OF THE LEARNING ORGANIZATION

Peter M. Senge

CURRENCY
DOUBLEDAY
New York London Toronto Sydney Auckland

it had not yet crystallized. It is crystallizing now with leaders of our MIT group: William O'Brien of Hanover Insurance; Edward Simon from Herman Miller, and Ray Stata, CEO of Analog Devices. All three of these men are involved in innovative, influential companies. All three have been involved in our research program for several years, along with leaders from Apple, Ford, Polaroid, Royal Dutch/Shell, and Trammell Crow.

For eleven years I have also been involved in developing and conducting Innovation Associates' Leadership and Mastery workshops, which have introduced people from all walks of life to the fifth discipline ideas that have grown out of our work at MIT, combined with IA's path-breaking work on building shared vision and personal mastery. Over four thousand managers have attended. We started out with a particular focus on corporate senior executives, but soon found that the basic disciplines such as systems thinking, personal mastery, and shared vision were relevant for teachers, public administrators and elected officials, students, and parents. All were in leadership positions of importance. All were in "organizations" that had still untapped potential for creating their future. All felt that to tap that potential required developing their own capacities, that is, learning.

So, this book is for the learners, especially those of us interested in the art and practice of collective learning.

For managers, this book should help in identifying the specific practices, skills, and disciplines that can make building learning organizations less of an occult art (though an art nonetheless).

For parents, this book should help in letting our children be our teachers, as well as we theirs—for they have much to teach us about learning as a way of life.

For citizens, the dialogue about why contemporary organizations are not especially good learners and about what is required to build learning organizations reveals some of the tools needed by communities and societies if they are to become more adept learners.

2

DOES YOUR ORGANIZATION HAVE A LEARNING DISABILITY?

Few large corporations live even half as long as a person. In 1983, a Royal Dutch/Shell survey found that one third of the firms in the Fortune "500" in 1970 had vanished.[1] Shell estimated that the average lifetime of the largest industrial enterprises is less than forty years, roughly half the lifetime of a human being! The chances are fifty-fifty that readers of this book will see their present firm disappear during their working career.

In most companies that fail, there is abundant evidence in advance that the firm is in trouble. This evidence goes unheeded, however, even when individual managers are aware of it. The organization as a whole cannot recognize impending threats, understand the implications of those threats, or come up with alternatives.

Perhaps under the laws of "survival of the fittest," this continual death of firms is fine for society. Painful though it may be for the employees and owners, it is simply a turnover of the economic soil, redistributing the resources of production to new companies and new cultures. But what if the high corporate mortality rate is only a symptom of deeper problems that afflict *all* companies, not just the ones

that die? What if even the most successful companies are poor learners—they survive but never live up to their potential? What if, in light of what organizations *could* be, "excellence" is actually "mediocrity"?

It is no accident that most organizations learn poorly. The way they are designed and managed, the way people's jobs are defined, and, most importantly, the way we have all been taught to think and interact (not only in organizations but more broadly) create fundamental learning disabilities. These disabilities operate despite the best efforts of bright, committed people. Often the harder they try to solve problems, the worse the results. What learning does occur takes place despite these learning disabilities—for they pervade all organizations to some degree.

Learning disabilities are tragic in children, especially when they go undetected. They are no less tragic in organizations, where they also go largely undetected. The first step in curing them is to begin to identify the seven learning disabilities:

1. "I AM MY POSITION"

We are trained to be loyal to our jobs—so much so that we confuse them with our own identities. When a large American steel company began closing plants in the early 1980s, it offered to train the displaced steelworkers for new jobs. But the training never "took"; the workers drifted into unemployment and odd jobs instead. Psychologists came in to find out why, and found the steelworkers suffering from acute identity crises. "How could I do anything else?" asked the workers. "I *am* a lathe operator."

When asked what they do for a living, most people describe the tasks they perform every day, not the *purpose* of the greater enterprise in which they take part. Most see themselves within a "system" over which they have little or no influence. They "do their job," put in their time, and try to cope with the forces outside of their control. Consequently, they tend to see their responsibilities as limited to the boundaries of their position.

Recently, managers from a Detroit auto maker told me of stripping down a Japanese import to understand why the Japanese were able to achieve extraordinary precision and reliability at lower cost on a particular assembly process. They found the same standard type of bolt used three times on the engine block. Each time it mounted a different type of component. On the American car, the same assembly required three different bolts, which required three different wrenches and three different inventories of bolts—making the car much slower and more costly to assemble. Why did the Americans use three separate bolts? Because the design organization in Detroit had three groups of engineers, each responsible for "their component only." The Japanese had one designer responsible for the entire engine mounting, and probably much more. The irony is that each of the three groups of American engineers considered their work successful because *their* bolt and assembly worked just fine.

When people in organizations focus only on their position, they have little sense of responsibility for the results produced when all positions interact. Moreover, when results are disappointing, it can be very difficult to know why. All you can do is assume that "someone screwed up."

2. "THE ENEMY IS OUT THERE"

A friend once told the story of a boy he coached in Little League, who after dropping three fly balls in right field, threw down his glove and marched into the dugout. "No one can catch a ball in that darn field," he said.

There is in each of us a propensity to find someone or something outside ourselves to blame when things go wrong. Some organizations elevate this propensity to a commandment: "Thou shalt always find an external agent to blame." Marketing blames manufacturing: "The reason we keep missing sales targets is that our quality is not competitive." Manufacturing blames engineering. Engineering blames marketing: "If they'd only quit screwing up our designs and let us design the products we are capable of, we'd be an industry leader."

The "enemy is out there" syndrome is actually a by-product of "I am my position," and the nonsystemic ways of looking at the world that it fosters. When we focus only on our position, we do not see how our own actions extend beyond the boundary of that position. When those actions have consequences that come back to hurt us, we misperceive these new problems as externally caused. Like the person being chased by his own shadow, we cannot seem to shake them.

The "Enemy Is Out There" syndrome is not limited to assigning

blame *within* the organization. During its last years of operation, the once highly successful People Express Airlines slashed prices, boosted marketing, and bought Frontier Airlines—all in a frantic attempt to fight back against the perceived cause of its demise: increasingly aggressive competitors. Yet, none of these moves arrested the company's mounting losses or corrected its core problem, service quality that had declined so far that low fares were its only remaining pull on customers.

For many American companies, "the enemy" has become Japanese competition, labor unions, government regulators, or customers who "betrayed us" by buying products from someone else. "The enemy is out there," however, is almost always an incomplete story. "Out there" and "in here" are usually part of a single system. This learning disability makes it almost impossible to detect the leverage which we can use "in here" on problems that straddle the boundary between us and "out there."

3. THE ILLUSION OF TAKING CHARGE

Being "proactive" is in vogue. Managers frequently proclaim the need for taking charge in facing difficult problems. What is typically meant by this is that we should face up to difficult issues, stop waiting for someone else to do something, and solve problems before they grow into crises. In particular, being proactive is frequently seen as an antidote to being "reactive"—waiting until a situation gets out of hand before taking a step. But is taking aggressive action against an external enemy really synonymous with being proactive?

Not too long ago, a management team in a leading property and liability insurance company with whom we were working got bitten by the proactiveness bug. The head of the team, a talented vice president for claims, was about to give a speech proclaiming that the company wasn't going to get pushed around anymore by lawyers litigating more and more claims settlements. The firm would beef up its own legal staff so that it could take more cases through to trial by verdict, instead of settling them out of court.

Then we and some members of the team began to look more systemically at the probable effects of the idea: the likely fraction of cases that might be won in court, the likely size of cases lost, the monthly direct and overhead costs regardless of who won or lost, and how long cases would probably stay in litigation. (The tool we used is discussed in Chapter 17, "Microworlds.") Interestingly, the team's scenarios pointed to *increasing* total costs because, given the quality of investigation done initially on most claims, the firm simply could not win enough of its cases to offset the costs of increased litigation. The vice president tore up his speech.

All too often, "proactiveness" is reactiveness in disguise. If we simply become more aggressive fighting the "enemy out there," we are reacting—regardless of what we call it. *True proactiveness comes from seeing how we contribute to our own problems.* It is a product of our way of thinking, not our emotional state.

4. THE FIXATION ON EVENTS

Two children get into a scrap on the playground and you come over to untangle them. Lucy says, "I hit him because he took my ball." Tommy says, "I took her ball because she won't let me play with her airplane." Lucy says, "He can't play with my airplane because he broke the propeller." Wise adults that we are, we say, "Now, now, children—just get along with each other." But are we really any different in the way we explain the entanglements we find ourselves caught in? We are conditioned to see life as a series of events, and for every event, we think there is one obvious cause.

Conversations in organizations are dominated by concern with events: last month's sales, the new budget cuts, last quarter's earnings, who just got promoted or fired, the new product our competitors just announced, the delay that just was announced in our new product, and so on. The media reinforces an emphasis on short-term events—after all, if it's more than two days' old it's no longer "news." Focusing on events leads to "event" explanations: "The Dow Jones average dropped sixteen points today," announces the newspaper, "because low fourth-quarter profits were announced yesterday." Such explanations may be true as far as they go, but they distract us from seeing the longer-term patterns of change that lie behind the events and from understanding the causes of those patterns.

Our fixation on events is actually part of our evolutionary programming. If you wanted to design a cave person for survival, ability to contemplate the cosmos would not be a high-ranking design criterion. What *is* important is the ability to see the saber-toothed tiger over your left shoulder and react quickly. The irony is that, *today*,

the primary threats to our survival, both of our organizations and of our societies, come not from sudden events but from slow, gradual processes; the arms race, environmental decay, the erosion of a society's public education system, increasingly obsolete physical capital, and decline in design or product quality (at least relative to competitors' quality) are all slow, gradual processes.

Generative learning cannot be sustained in an organization if people's thinking is dominated by short-term events. If we focus on events, the best we can ever do is predict an event before it happens so that we can react optimally. But we cannot learn to create.

5. THE PARABLE OF THE BOILED FROG

Maladaptation to gradually building threats to survival is so pervasive in systems studies of corporate failure that it has given rise to the parable of the "boiled frog." If you place a frog in a pot of boiling water, it will immediately try to scramble out. But if you place the frog in room temperature water, and don't scare him, he'll stay put. Now, if the pot sits on a heat source, and if you gradually turn up the temperature, something very interesting happens. As the temperature rises from 70 to 80 degrees F., the frog will do nothing. In fact, he will show every sign of enjoying himself. As the temperature gradually increases, the frog will become groggier and groggier, until he is unable to climb out of the pot. Though there is nothing restraining him, the frog will sit there and boil. Why? Because the frog's internal apparatus for sensing threats to survival is geared to sudden changes in his environment, not to slow, gradual changes.

Something similar happened to the American automobile industry. In the 1960s, it dominated North American production. That began to change very gradually. Certainly, Detroit's Big Three did not see Japan as a threat to their survival in 1962, when the Japanese share of the U.S. market was below 4 percent. Nor in 1967, when it was less than 10 percent. Nor in 1974, when it was under 15 percent. By the time the Big Three began to look critically at its own practices and core assumptions, it was the early 1980s, and the Japanese share of the American market had risen to 21.3 percent. By 1989, the Japanese share was approaching 30 percent, and the American auto industry could account for only about 60 percent of the cars sold in the U.S.[2] It is still not clear whether this particular frog will have the strength to pull itself out of the hot water.

Learning to see slow, gradual processes requires slowing down our frenetic pace and paying attention to the subtle as well as the dramatic. If you sit and look into a tidepool, initially you won't see much of anything going on. However, if you watch long enough, after about ten minutes the tidepool will suddenly come to life. The world of beautiful creatures is always there, but moving a bit too slowly to be seen at first. The problem is our minds are so locked in one frequency, it's as if we can only see at 78 rpm; we can't see anything at 33⅓. We will not avoid the fate of the frog until we learn to slow down and see the gradual processes that often pose the greatest threats.

6. THE DELUSION OF LEARNING FROM EXPERIENCE

The most powerful learning comes from direct experience. Indeed, we learn eating, crawling, walking, and communicating through direct trial and error—through taking an action and seeing the consequences of that action; then taking a new and different action. But what happens when we can no longer observe the consequences of our actions? What happens if the primary consequences of our actions are in the distant future or in a distant part of the larger system within which we operate? We each have a "learning horizon," a breadth of vision in time and space within which we assess our effectiveness. When our actions have consequences beyond our learning horizon, it becomes impossible to learn from direct experience.

Herein lies the core *learning dilemma* that confronts organizations: *we learn best from experience but we never directly experience the consequences of many of our most important decisions.* The most critical decisions made in organizations have systemwide consequences that stretch over years or decades. Decisions in R&D have first-order consequences in marketing and manufacturing. Investing in new manufacturing facilities and processes influences quality and delivery reliability for a decade or more. Promoting the right people into leadership positions shapes strategy and organizational climate for years. These are exactly the types of decisions where there is the least opportunity for trial and error learning.

Cycles are particularly hard to see, and thus learn from, if they last longer than a year or two. As systems-thinking writer Draper Kauffman, Jr., points out, most people have short memories. "When

a temporary oversupply of workers develops in a particular field," he wrote, "everyone talks about the big surplus and young people are steered away from the field. Within a few years, this creates a shortage, jobs go begging, and young people are frantically urged into the field—which creates a surplus. Obviously, the best time to start training for a job is when people have been talking about a surplus for several years and few others are entering it. That way, you finish your training just as the shortage develops."[3]

Traditionally, organizations attempt to surmount the difficulty of coping with the breadth of impact from decisions by breaking themselves up into components. They institute functional hierarchies that are easier for people to "get their hands around." But, functional divisions grow into fiefdoms, and what was once a convenient division of labor mutates into the "stovepipes" that all but cut off contact between functions. The result: analysis of the most important problems in a company, the complex issues that cross functional lines, becomes a perilous or nonexistent exercise.

7. THE MYTH OF THE MANAGEMENT TEAM

Standing forward to do battle with these dilemmas and disabilities is "the management team," the collection of savvy, experienced managers who represent the organization's different functions and areas of expertise. Together, they are supposed to sort out the complex cross-functional issues that are critical to the organization. What confidence do we have, really, that typical management teams can surmount these learning disabilities?

All too often, teams in business tend to spend their time fighting for turf, avoiding anything that will make them look bad personally, and pretending that everyone is behind the team's collective strategy —maintaining the *appearance* of a cohesive team. To keep up the image, they seek to squelch disagreement; people with serious reservations avoid stating them publicly, and joint decisions are watered-down compromises reflecting what everyone can live with, or else reflecting one person's view foisted on the group. If there is disagreement, it's usually expressed in a manner that lays blame, polarizes opinion, and fails to reveal the underlying differences in assumptions and experience in a way that the team as a whole could learn.

"Most management teams break down under pressure," writes Harvard's Chris Argyris—a longtime student of learning in management teams. "The team may function quite well with routine issues. But when they confront complex issues that may be embarrassing or threatening, the 'teamness' seems to go to pot."[4]

Argyris argues that most managers find collective inquiry inherently threatening. School trains us never to admit that we do not know the answer, and most corporations reinforce that lesson by rewarding the people who excel in advocating their views, not inquiring into complex issues. (When was the last time someone was rewarded in your organization for raising difficult questions about the company's current policies rather than solving urgent problems?) Even if we feel uncertain or ignorant, we learn to protect ourselves from the pain of appearing uncertain or ignorant. That very process blocks out any new understandings which might threaten us. The consequence is what Argyris calls "skilled incompetence"—teams full of people who are incredibly proficient at keeping themselves from learning.

DISABILITIES AND DISCIPLINES

These learning disabilities have been with us for a long time. In *The March of Folly,* Barbara Tuchman traces the history of devastating large-scale policies "pursued contrary to ultimate self-interest,"[5] from the fall of the Trojans through the U.S. involvement in Vietnam. In story after story, leaders could not see the consequences of their own policies, even when they were warned in advance that their own survival was at stake. Reading between the lines of Tuchman's writing, you can see that the fourteenth-century Valois monarchs of France suffered from "I am my position" disabilities—when they devalued currency, they literally didn't realize they were driving the new French middle class toward insurrection.

In the mid-1700s Britain had a bad case of boiled frog. The British went through "a full decade," wrote Tuchman, "of mounting conflict with the [American] colonies without any [British official] sending a representative, much less a minister, across the Atlantic . . . to find out what was endangering the relationship . . ."[6] By 1776, the start of the American Revolution, the relationship was irrevocably endangered. Elsewhere, Tuchman describes the Roman Catholic cardinals of the fifteenth and sixteenth centuries, a tragic management "team" in which piety demanded that they present an appear-

ance of agreement. However, behind-the-scenes backstabbing (in some cases, literal backstabbing) brought in opportunistic popes whose abuses of office provoked the Protestant Reformation.

We live in no less perilous times today, and the same learning disabilities persist, along with their consequences. The five disciplines of the learning organization can, I believe, act as antidotes to these learning disabilities. But first, we must see the disabilities more clearly—for they are often lost amid the bluster of day-to-day events.

3

PRISONERS OF THE SYSTEM, OR PRISONERS OF OUR OWN THINKING?

In order to see the learning disabilities in action, it helps to start with a laboratory experiment—a microcosm of how real organizations function, where you can see the consequences of your decisions play out more clearly than is possible in real organizations. For this reason, we often invite people to take part in a simulation called the "beer game," first developed in the 1960s at the Massachusetts Institute of Technology's Sloan School of Management. Because it is a "laboratory replica" of a real setting, rather than reality itself, we can isolate the disabilities and their causes more sharply than is possible in real organizations. This reveals that the problems originate in basic ways of thinking and interacting, more than in peculiarities of organization structure and policy.

The beer game does this by immersing us in a type of organization which is rarely noticed but widely prevalent: a production/distribution system, the kind responsible for producing and shipping consumer and commercial goods in all industrial countries. In this case, it's a system for producing and distributing a single brand of beer. The players at each position are completely free to make any deci-

4

THE LAWS OF THE FIFTH DISCIPLINE[1]

1. *Today's problems come from yesterday's "solutions."*

Once there was a rug merchant who saw that his most beautiful carpet had a large bump in its center.[2] He stepped on the bump to flatten it out—and succeeded. But the bump reappeared in a new spot not far away. He jumped on the bump again, and it disappeared —for a moment, until it emerged once more in a new place. Again and again he jumped, scuffing and mangling the rug in his frustration; until finally he lifted one corner of the carpet and an angry snake slithered out.

Often we are puzzled by the causes of our problems; when we merely need to look at our own solutions to other problems in the past. A well-established firm may find that this quarter's sales are off sharply. Why? Because the highly successful rebate program last quarter led many customers to buy then rather than now. Or a new manager attacks chronically high inventory costs and "solves" the problem—except that the salesforce is now spending 20 percent more time responding to angry complaints from customers who are

still waiting for late shipments, and the rest of its time trying to convince prospective customers that they can have "any color they want so long as it's black."

Police enforcement officials will recognize their own version of this law: arresting narcotics dealers on Thirtieth Street, they find that they have simply transferred the crime center to Fortieth Street. Or, even more insidiously, they learn that a new citywide outbreak of drug-related crime is the result of federal officials intercepting a large shipment of narcotics—which reduced the drug supply, drove up the price, and caused more crime by addicts desperate to maintain their habit.

Solutions that merely shift problems from one part of a system to another often go undetected because, unlike the rug merchant, those who "solved" the first problem are different from those who inherit the new problem.

2. *The harder you push, the harder the system pushes back.*

In George Orwell's *Animal Farm,* the horse Boxer always had the same answer to any difficulty: "I will work harder," he said. At first, his well-intentioned diligence inspired everyone, but gradually, his hard work began to backfire in subtle ways. The harder he worked, the more work there was to do. What he didn't know was that the pigs who managed the farm were actually manipulating them all for their own profit. Boxer's diligence actually helped to keep the other animals from seeing what the pigs were doing.[3] Systems thinking has a name for this phenomenon: "Compensating feedback": when well-intentioned interventions call forth responses from the system that offset the benefits of the intervention. We all know what it feels like to be facing compensating feedback—the harder you push, the harder the system pushes back; the more effort you expend trying to improve matters, the more effort seems to be required.

Examples of compensating feedback are legion. Many of the best intentioned government interventions fall prey to compensating feedback. In the 1960s there were massive programs to build low-income housing and improve job skills in decrepit inner cities in the United States. Many of these cities were even worse off in the 1970s despite the largesse of government aid. Why? One reason was that low-income people migrated from other cities and from rural areas to those cities with the best aid programs. Eventually, the new housing units became overcrowded and the job training programs were

swamped with applicants. All the while, the city's tax base continued to erode, leaving more people trapped in economically depressed areas.

Similar compensating feedback processes have operated to thwart food and agricultural assistance to developing countries. More food available has been "compensated for" by reduced deaths due to malnutrition, higher net population growth, and eventually more malnutrition.

Similarly, efforts to correct the U.S. trade imbalance by letting the value of the dollar fall in the mid-1980s were compensated for by foreign competitors who let prices of their goods fall in parallel (for countries whose currency was "pegged to the dollar," their prices adjusted automatically). Efforts by foreign powers to suppress indigenous guerrilla fighters often lead to further legitimacy for the guerrillas' cause, thereby strengthening their resolve and support, and leading to still further resistance.

Many companies experience compensating feedback when one of their products suddenly starts to lose its attractiveness in the market. They push for more aggressive marketing; that's what always worked in the past, isn't it? They spend more on advertising, and drop the price; these methods may bring customers back temporarily, but they also draw money away from the company, so it cuts corners to compensate. The quality of its service (say, its delivery speed or care in inspection) starts to decline. In the long run, the more fervently the company markets, the more customers it loses.

Nor is compensating feedback limited to "large systems"—there are plenty of personal examples. Take the person who quits smoking only to find himself gaining weight and suffering such a loss in self-image that he takes up smoking again to relieve the stress. Or the protective mother who wants so much for her young son to get along with his schoolmates that she repeatedly steps in to resolve problems and ends up with a child who never learns to settle differences by himself. Or the enthusiastic newcomer so eager to be liked that she never responds to subtle criticisms of her work and ends up embittered and labeled "a difficult person to work with."

Pushing harder, whether through an increasingly aggressive intervention or through increasingly stressful withholding of natural instincts, is exhausting. Yet, as individuals and organizations, we not only get drawn into compensating feedback, we often glorify the suffering that ensues. When our initial efforts fail to produce lasting improvements, we "push harder"—faithful, as was Boxer, to the

creed that hard work will overcome all obstacles, all the while blinding ourselves to how we are contributing to the obstacles ourselves.

3. *Behavior grows better before it grows worse.*

Low-leverage interventions would be much less alluring if it were not for the fact that many actually work, in the short term. New houses get built. The unemployed are trained. Starving children are spared. Lagging orders turn upward. We stop smoking, relieve our child's stress, and avoid a confrontation with a new coworker. Compensating feedback usually involves a "delay," a time lag between the short-term benefit and the long-term disbenefit. *The New Yorker* once published a cartoon in which a man sitting in an armchair pushes over a giant domino encroaching upon him from the left. "At last, I can relax," he's obviously telling himself in the cartoon. Of course, he doesn't see that the domino is toppling another domino, which in turn is about to topple another, and another, and that the chain of dominoes behind him will eventually circle around his chair and strike him from the right.

The better before worse response to many management interventions is what makes political decision making so counterproductive. By "political decision making," I mean situations where factors other than the intrinsic merits of alternative courses of action weigh in making decisions—factors such as building one's own power base, or "looking good," or "pleasing the boss." In complex human systems there are always many ways to make things look better in the short run. Only eventually does the compensating feedback come back to haunt you.

The key word is "eventually." The delay in, for example, the circle of dominoes, explains why systemic problems are so hard to recognize. A typical solution feels wonderful, when it first cures the symptoms. Now there's improvement; or maybe even the problem has gone away. It may be two, three, or four years before the problem returns, or some new, worse problem arrives. By that time, given how rapidly most people move from job to job, someone new is sitting in the chair.

4. *The easy way out usually leads back in.*

In a modern version of an ancient Sufi story, a passerby encounters a drunk on his hands and knees under a street lamp. He offers to help and finds out that the drunk is looking for his house keys. After several minutes, he asks, "Where did you drop them?" The drunk replies that he dropped them outside his front door. "Then why look for them here?" asks the passerby. "Because," says the drunk, "there is no light by my doorway."

We all find comfort applying familiar solutions to problems, sticking to what we know best. Sometimes the keys are indeed under the street lamp; but very often they are off in the darkness. After all, if the solution *were* easy to see or obvious to everyone, it probably would already have been found. Pushing harder and harder on familiar solutions, while fundamental problems persist or worsen, is a reliable indicator of nonsystemic thinking—what we often call the "what we need here is a bigger hammer" syndrome.

5. *The cure can be worse than the disease.*

Sometimes the easy or familiar solution is not only ineffective; sometimes it is addictive and dangerous. Alcoholism, for instance, may start as simple social drinking—a solution to the problem of low self-esteem or work-related stress. Gradually, the cure becomes worse than the disease; among its other problems it makes self-esteem and stress even worse than they were to begin with.

The long-term, most insidious consequence of applying nonsystemic solutions is increased need for more and more of the solution. This is why ill-conceived government interventions are not just ineffective, they are "addictive" in the sense of fostering increased dependency and lessened abilities of local people to solve their own problems. The phenomenon of short-term improvements leading to long-term dependency is so common, it has its own name among systems thinkers—it's called "Shifting the Burden to the Intervenor." The intervenor may be federal assistance to cities, food relief agencies, or welfare programs. All "help" a host system, only to leave the system fundamentally weaker than before and more in need of further help.

Finding examples of shifting the burden to the intervenor, as natural resource expert and writer Donella Meadows says, "is easy and fun and sometimes horrifying"[4] and hardly limited to government intervenors. We shift the burden of doing simple math from our knowledge of arithmetic to a dependency on pocket calculators. We take away extended families, and shift the burden for care of the aged to nursing homes. In cities, we shift the burden from diverse local communities to housing projects. The Cold War shifted respon-

sibility for peace from negotiation to armaments, thereby strengthening the military and related industries. In business, we can shift the burden to consultants or other "helpers" who make the company dependent on them, instead of training the client managers to solve problems themselves. Over time, the intervenor's power grows—whether it be a drug's power over a person, or the military budget's hold over an economy, the size and scope of foreign assistance agencies, or the budget of organizational "relief agencies."

Shifting the Burden structures show that any long-term solution must, as Meadows says, "strengthen the ability of the system to shoulder its own burdens." Sometimes that is difficult; other times it is surprisingly easy. A manager who has shifted the burden of his personnel problems onto a Human Relations Specialist may find that the hard part is deciding to take the burden back; once that happens, learning how to handle people is mainly a matter of time and commitment.

6. *Faster is slower.*

This, too, is an old story: the tortoise may be slower, but he wins the race. For most American business people the best rate of growth is fast, faster, fastest. Yet, virtually all natural systems, from ecosystems to animals to organizations, have intrinsically optimal rates of growth. The optimal rate is far less than the fastest possible growth. When growth becomes excessive—as it does in cancer—the system itself will seek to compensate by slowing down; perhaps putting the organization's survival at risk in the process. In Chapter 8, the story of People Express airlines offers a good example of how faster can lead to slower—or even full stop—in the long run.

Observing these characteristics of complex systems, noted biologist and essayist Lewis Thomas has observed, "When you are dealing with a complex social system, such as an urban center or a hamster, with things about it that you are dissatisfied with and eager to fix, you cannot just step in and set about fixing with much hope of helping. This realization is one of the sore discouragements of our century."[5]

When managers first start to appreciate how these systems principles have operated to thwart many of their own favorite interventions, they can be discouraged and disheartened. The systems principles can even become excuses for inaction—for doing nothing

rather than possibly taking actions that might backfire, or even make matters worse. This is a classic case of "a little knowledge being a dangerous thing." For the real implications of the systems perspective are not inaction but a new type of action rooted in a new way of thinking—systems thinking is both more challenging *and* more promising than our normal ways of dealing with problems.

7. *Cause and effect are not closely related in time and space.*

Underlying all of the above problems is a fundamental characteristic of complex human systems: "cause" and "effect" are not close in time and space. By "effects," I mean the obvious symptoms that indicate that there are problems—drug abuse, unemployment, starving children, falling orders, and sagging profits. By "cause" I mean the interaction of the underlying system that is most responsible for generating the symptoms, and which, if recognized, could lead to changes producing lasting improvement. Why is this a problem? Because most of us assume they *are*—most of us assume, most of the time, that cause and effect *are* close in time and space.

When we play as children, problems are never far away from their solutions—as long, at least, as we confine our play to one group of toys. Years later, as managers, we tend to believe that the world works the same way. If there is a problem on the manufacturing line, we look for a cause in manufacturing. If salespeople can't meet targets, we think we need new sales incentives or promotions. If there is inadequate housing, we build more houses. If there is inadequate food, the solution must be more food.

As the players in the beer game described in Chapter 3 eventually discover, the root of our difficulties is neither recalcitrant problems nor evil adversaries—but ourselves. There is a fundamental mismatch between the nature of reality in complex systems and our predominant ways of thinking about that reality. The first step in correcting that mismatch is to let go of the notion that cause and effect are close in time and space.

8. *Small changes can produce big results—but the areas of highest leverage are often the least obvious.*

Some have called systems thinking the "new dismal science" because it teaches that most obvious solutions don't work—at best, they improve matters in the short run, only to make things worse in the long run. But there is another side to the story. For systems

thinking also shows that small, well-focused actions can sometimes produce significant, enduring improvements, if they're in the right place. Systems thinkers refer to this principle as "leverage."

Tackling a difficult problem is often a matter of seeing where the high leverage lies, a change which—with a minimum of effort—would lead to lasting, significant improvement.

The only problem is that high-leverage changes are usually highly *nonobvious* to most participants in the system. They are not "close in time and space" to obvious problem symptoms. This is what makes life interesting.

Buckminster Fuller had a wonderful illustration of leverage that also served as his metaphor for the principle of leverage—the "trim tab." A trim tab is a small "rudder on the rudder" of a ship. It is only a fraction the size of the rudder. Its function is to make it easier to turn the rudder, which, then, makes it easier to turn the ship. The larger the ship, the more important is the trim tab because a large volume of water flowing around the rudder can make it difficult to turn.

But what makes the trim tab such a marvelous metaphor for leverage is not just its effectiveness, but its nonobviousness. If you knew absolutely nothing about hydrodynamics and you saw a large oil tanker plowing through the high seas, where would you push if you wanted the tanker to turn left? You would probably go to the bow and try to push it to the left. Do you have any idea how much force it requires to turn an oil tanker going fifteen knots by pushing on its bow? The leverage lies in going to the stern and pushing the tail end of the tanker to the right, in order to turn the front to the left. This, of course, is the job of the rudder. But in what direction does the rudder turn in order to get the ship's stern to turn to the right? Why to the left, of course.

You see, ships turn because their rear end is "sucked around." The rudder, by being turned into the oncoming water, compresses the water flow and creates a pressure differential. The pressure differential pulls the stern in the opposite direction as the rudder is turned. This is exactly the same way that an airplane flies: the airplane's wing creates a pressure differential and the airplane is "sucked" upward.

The trim tab—this very small device that has an enormous effect on the huge ship—does the same for the rudder. When it is turned to one side or the other, it compresses the water flowing around the rudder and creates a small pressure differential that "sucks the rudder" in the desired direction. But, if you want the rudder to turn to the left, what direction do you turn the trim tab?—to the right, naturally.

The entire system—the ship, the rudder, and the trim tab—is marvelously engineered through the principle of leverage. Yet, its functioning is totally nonobvious if you do not understand the force of hydrodynamics.

So, too, are the high-leverage changes in human systems nonobvious *until* we understand the forces at play in those systems.

There are no simple rules for finding high-leverage changes, but there are ways of thinking that make it more likely. Learning to see underlying "structures" rather than "events" is a starting point; each of the "systems archetypes" developed below suggests areas of high- and low-leverage change.

Thinking in terms of processes of change rather than "snapshots" is another.

9. *You* can *have your cake and eat it too—but not at once.*

Sometimes, the knottiest dilemmas, when seen from the systems point of view, aren't dilemmas at all. They are artifacts of "snapshot" rather than "process" thinking, and appear in a whole new light once you think consciously of change over time.

For years, for example, American manufacturers thought they had to choose between low cost and high quality. "Higher quality products cost more to manufacture," they thought. "They take longer to assemble, require more expensive materials and components, and entail more extensive quality controls." What they didn't consider was all the ways the increasing quality and lowering costs could go hand in hand, over time. What they didn't consider was how basic improvements in work processes could eliminate rework, eliminate quality inspectors, reduce customer complaints, lower warranty costs, increase customer loyality, and reduce advertising and sales promotion costs. They didn't realize that they could have both goals, if they were willing to wait for one while they focused on the other. Investing time and money to develop new skills and methods of assembly, including new methods for involving everyone responsible for improving quality, is an up front "cost." Quality and costs may *both* go up in the ensuing months; although some cost savings (like reduced rework) may be achieved fairly quickly, the full range of cost savings may take several years to harvest.

Many apparent dilemmas, such as central versus local control, and happy committed employees versus competitive labor costs, and rewarding individual achievement versus having everyone feel valued are by-products of static thinking. They only appear as rigid "either-or" choices, because we think of what is possible at a fixed point in time. Next month, it may be true that we must choose one or the other, but the real leverage lies in seeing how both can improve over time.[6]

10. *Dividing an elephant in half does not produce two small elephants.*

Living systems have integrity. Their character depends on the whole. The same is true for organizations; to understand the most challenging managerial issues requires seeing the whole system that generates the issues.

Another Sufi tale illustrates the point of this law. As three blind men encountered an elephant, each exclaimed aloud. "It is a large rough thing, wide and broad, like a rug," said the first, grasping an ear. The second, holding the trunk, said, "I have the real facts. It is a straight and hollow pipe." And the third, holding a front leg, said, "It is mighty and firm, like a pillar." Are the three blind men any different from the heads of manufacturing, marketing, and research in many companies? Each sees the firm's problems clearly, but none see how the policies of their department interact with the others. Interestingly, the Sufi story concludes by observing that "Given these men's way of knowing, they will never know an elephant."

Seeing "whole elephants" does not mean that every organizational issue can be understood only by looking at the entire organization. Some issues *can* be understood only by looking at how major functions such as manufacturing, marketing, and research interact; but there are other issues where critical systemic forces arise within a given functional area; and others where the dynamics of an entire industry must be considered. The key principle, called the "principle of the system boundary," is that the interactions that must be examined are those most important to the issue at hand, *regardless* of parochial organizational boundaries.

What makes this principle difficult to practice is the way organizations are designed to keep people from seeing important interactions. One obvious way is by enforcing rigid internal divisions that inhibit inquiry across divisional boundaries, such as those that grow up between marketing, manufacturing, and research. Another is by

"leaving" problems behind us, for someone else to clean up. Many European cities have avoided the problems of crime, entrenched poverty, and helplessness that afflict so many American inner cities because they have forced themselves to face the balances that a healthy urban area must maintain. One way they have done this is by maintaining large "green belts" around the city that discourage the growth of suburbs and commuters who work in the city but live outside it. By contrast, many American cities have encouraged steady expansion of surrounding suburbs, continually enabling wealthier residents to move further from the city center and its problems. (Impoverished areas today, such as Harlem in New York and Roxbury in Boston were originally upper-class suburbs.) Corporations do the same thing by continually acquiring new businesses and "harvesting" what they choose to regard as "mature" businesses rather than reinvesting in them.

Incidentally, sometimes people go ahead and divide an elephant in half anyway. You don't have two small elephants then; you have a mess. By a mess, I mean a complicated problem where there is no leverage to be found because the leverage lies in interactions that cannot be seen from looking only at the piece you are holding.

11. *There is no blame.*

We tend to blame outside circumstances for our problems. "Someone else"—the competitors, the press, the changing mood of the marketplace, the government—did it to us. Systems thinking shows us that there is no outside; that you and the cause of your problems are part of a single system. The cure lies in your relationship with your "enemy."

7

THE PRINCIPLE OF LEVERAGE

The bottom line of systems thinking is leverage—seeing where actions and changes in structures can lead to significant, enduring improvements. Often, leverage, follows the principle of economy of means: where the best results come not from large-scale efforts but from small well-focused actions. Our nonsystemic ways of thinking are so damaging specifically because they consistently lead us to focus on low-leverage changes: we focus on symptoms where the stress is greatest. We repair or ameliorate the symptoms. But such efforts only make matters better in the short run, at best, and worse in the long run.

It's hard to disagree with the *principle* of leverage. But the leverage in most real-life systems, such as most organizations, is not obvious to most of the actors in those systems. They don't see the "structures" underlying their actions. The purpose of the systems archetypes, such as limits to growth and shifting the burden, is to help see those structures and thus find the leverage, especially amid the pressures and crosscurrents of real-life business situations.

For example, let's look at a real story that we have seen again and again. In fact, the following case is a mosaic pieced together from several specific instances where the same story unfolded.[1]

WHEN WE CREATE OUR OWN "MARKET LIMITATIONS"

In the mid-1960s a new electronics company was founded with a unique high-tech product—a new type of computer. Thanks to its engineering know-how, WonderTech had a virtual lock on its market niche. There was enormous demand for its products, and there were enough investors to guarantee no financial constraints.

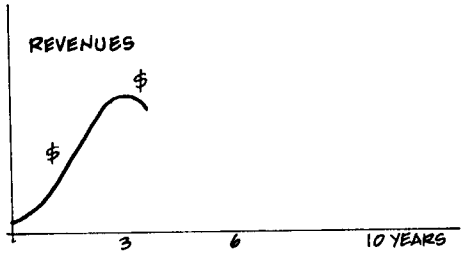
Yet the company, which began with meteoric growth, never sustained its rapid growth after its first three years. Eventually it declined into bankruptcy.

That fate would have seemed unthinkable during WonderTech's first three years, when sales doubled annually. In fact, sales were so good that backlogs of orders began to pile up midway through their second year. Even with steadily increasing manufacturing capacity (more factories, more shifts, more advanced technology), the demand grew so fast that delivery times slipped a bit. Originally they had promised to deliver machines within eight weeks, and they intended to return to that standard; but with some pride, the top management told investors, "Our computers are so good that some customers are willing to wait fourteen weeks for them. We know it's a problem, and we're working to fix it, but nonetheless they're *still* glad to get the machines, and they love 'em when they get 'em."

The top management knew that they had to add production capacity. After six months of study, while manufacturing changed from a one-shift to a two-shift operation, they decided to borrow the money to build a new factory. To make sure the growth kept up, they pumped much of the incoming revenue directly back into sales and marketing. Since the company sold its products only through a direct sales force, that meant hiring and training more sales people. During the company's third year, the sales force doubled.

But despite this, sales started to slump at the end of the third year.

By the middle of the fourth year, sales had dropped off to crisis levels. The curve of sales, so far, looked like this:

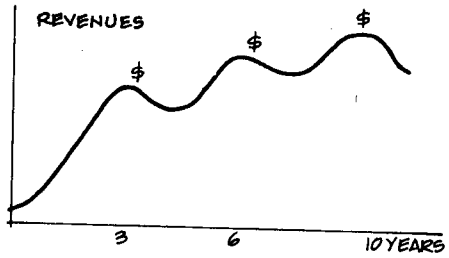


At this point, the new factory came on-line. "We've hired all these people," said the vice president of manufacturing. "What are we going to do with them?" The top management began to panic about what to tell their investors, after they had spent all this money on a new manufacturing facility. It was as if everyone in the company simultaneously turned and looked at one person: the marketing and sales vice president.

Not surprisingly, the marketing and sales VP had become a rising star in the company. His force had done so well during the initial boom that he had anticipated a promotion. Now there was a slump, and he was under heat to turn sales around. So he took the most likely course of action. He held high-powered sales meetings with a single message: "Sell! Sell! Sell!" He fired the low performers. He increased sales incentives, added special discounts, and ran new advertising promotions describing the machine in an exciting new way.

And indeed, sales rose again. The sales and marketing VP found himself once more hailed as a hero, a born-again motivator who could take charge of a tough situation. Once again, WonderTech was in the happy position of having rapidly rising orders. Eventually, backlogs began to grow again. And after a year, delivery times began to rise again—first to ten weeks, then to twelve, and eventually to sixteen. The debate over adding capacity started anew. But this time, having been stung on the last occasion, the top management was still more cautious. Eventually, approval of a new facility was granted, but no sooner had the papers been signed than a new sales crisis started. The slump was so bad that the sales and marketing vice president lost his job.

Over the next several years, and through a succession of marketing managers, the same situation recurred. High sales growth occurred in spurts, always followed by periods of low or no growth. The pattern looked like this:



The company prospered modestly, but never came close to fulfilling its original potential. Gradually, the top managers began to fear that other firms would learn how to produce competing products. They frantically introduced ill-conceived improvements in the product. They continued to push hard on marketing. But sales never returned to the original rate of growth. The "wonder" went out of WonderTech. Eventually, the company collapsed.

In his final statement to the lingering members of his executive team, the CEO said, "We did great under the circumstances, but the demand just isn't there. Clearly it was a limited market—a niche which we have effectively filled."

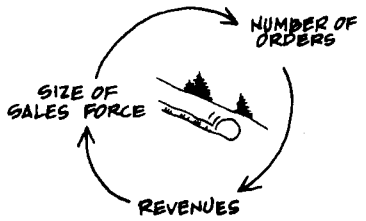
The tale of WonderTech is hardly a novel one. Of every ten start-up companies, one half will disappear within their first five years, only four survive into their tenth year, and only three into their fifteenth year.[2] Whenever a company fails, people always point to specific events to explain the "causes" of the failure: product problems, inept managers, loss of key people, unexpectedly aggressive competition, or business downturns. Yet, the deeper systemic causes for unsustained growth are not recognized. With the aid of the systems archetypes, these causes often can be understood and, in many cases, successful policies can be formulated. The irony of WonderTech is that, given its product and its market potential, it could have grown vigorously for many years, not just two or three.

WonderTech's managers could not see the reasons for their own decline. This was not for lack of information. They had all the significant facts—the same facts that you have after reading this story. But they could not see the structures implicit in those facts.

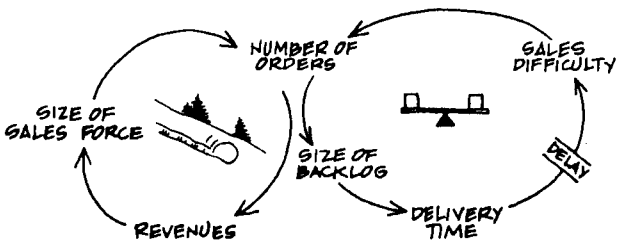
As a systems thinker trying to diagnose WonderTech's problem, you would look for clues—anything that might suggest an archetype.

You'd begin with the most obvious pattern of behavior: growth leaped up at first, amplifying itself to grow stronger and stronger. But the growth gradually slowed, and eventually sales stopped growing altogether. This pattern is the classic symptom of limits to growth.

There are many possible reinforcing (amplifying) processes that could have produced WonderTech's original rapid sales growth. Investment in products, investment in advertising, good word of mouth —all could have reinforced past success into future success. But one especially evident in the WonderTech story was the reinforcing process created by investing revenues in increasing the sales force: more sales meant more revenues, which meant hiring salespeople, which meant more sales.



The other part of any limits to growth structure, of course, is a balancing (stabilizing) process. Something had to make the sales slow down. But sales only slow down when a market is saturated, when competition grows, or when customers grow disenchanted. In this case, the need for the WonderTech computer was still strong, and there was no significant competition. There was one factor which turned customers off: long delivery times. As backlogs rise relative to production capacity, delivery times increase. A reputation for poor delivery service builds, eventually making it harder for WonderTech's salespeople to make more sales. The limits to growth structure, then, looks like this:



In a limits to growth structure, the worst thing you can do is push hard on the reinforcing process. But that's exactly what WonderTech's managers did. They tried to reignite the "engine of growth" through sales incentives, marketing promotions, and minor product improvements—none of which had any leverage. The leverage would lie with the balancing process.

Why wasn't that balancing process noticed? First, WonderTech's financially oriented top management did not pay much attention to their delivery service. They mainly tracked sales, profits, return on investment, and market share. So long as these were healthy, delivery times were the least of their concerns. When financial performance weakened, pressures shifted to boost orders. Usually, by this time, delivery times were already starting to come down because orders were falling. Thus, whether times were good, or times were bad, the top management paid little attention to the time customers had to wait to get their computers.

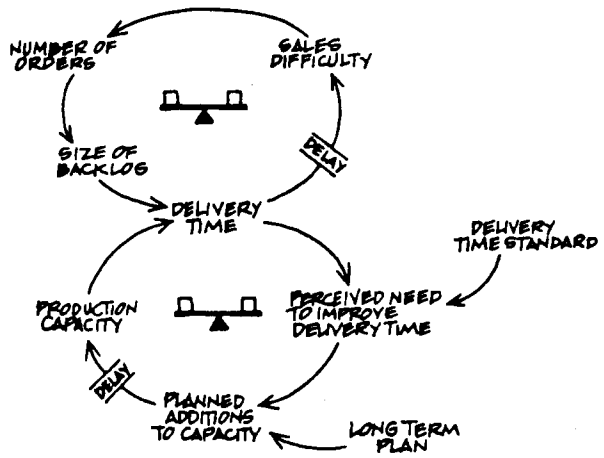
Even if they had, they would not necessarily have seen delivery time as a key factor affecting sales. Delivery times had been getting longer and longer, for more than a year and a half, before the first sales crisis hit. This reinforced an attitude among top management: "Customers don't care about late shipments." But that complacency was misplaced; customers *were* concerned, but their concern was obscured, to WonderTech's management, by a built-in delay in the system. A customer would say, "I want the machine delivered in eight weeks." The salesperson would say fine. But after nine, ten, or twelve weeks, there would still be no machine. After several more months, gossip would filter out. However, the number of potential customers was vast. And the gossip had little effect until it eventually mushroomed into a widespread reputation for poor deliveries. In the chart above, this delay falls in the arrow between Delivery Time and Sales Difficulty.

WonderTech's managers had fallen prey to the classic learning disability of being unable to detect cause and effect which were separated in time. In general, if you wait until demand falls off, and *then* get concerned about delivery time, it's way too late. The slow delivery time has already begun to correct itself—temporarily. At WonderTech, delivery times grew worse during the third year, the last year of rapid growth. Then they improved during the downturn that followed; but then they grew worse again.

Over the entire ten-year history of the firm, there was an unfortunate trend of rising delivery times, interrupted by periodic improve-

ments. Alongside that was a gradual decline in the overall health of the system—as seen in slowing growth and declining profits. The company made money in spurts, but lost money like mad in every downturn. The euphoria of the early growth period gave way to discouragement and, eventually, despair. People felt, at the end, as if they were victims. While the CEO said publicly that they had done great under the circumstances, privately he acknowledged that they had been misled by initial marketing projections that forecast a huge potential market that was never realized.

What no one realized was that the situation at WonderTech described a classic shifting the burden structure. There was a problem symptom (delivery time) that worsened steadily, albeit with periodic improvements. The overall health of the enterprise was also steadily worsening, and there was a growing feeling of victimization. As a systems thinker, you would first identify that key problem symptom, and then the symptomatic and fundamental responses to it. In this case, the fundamental response (the lower circle in the diagram below) is to expand production capacity to control delivery time. Delivery times above WonderTech's standard indicate the need for more capacity, which once it eventually arrives on-line, will correct long delivery times. But if this fundamental response is slow in coming, the burden shifts to the symptomatic response (the upper circle) of customer dissatisfaction in declining orders. Since WonderTech's managers didn't solve the problem of long delivery times by adding manufacturing capacity rapidly enough, disgruntled would-be customers "solved" the problem by walking away.



Moreover, as WonderTech allowed the "disgruntled customer" process to operate, the symptomatic response tended to get stronger and stronger—just as you'd expect from a shifting the burden structure. This occurred as WonderTech's reputation for poor delivery service spread through its market; whenever WonderTech entered a new period of rising delivery times, word spread more and more rapidly. Meanwhile, the fundamental response grew weaker. "Having been stung" when they added capacity that was left idle by falling orders, WonderTech's top management grew increasingly cautious in committing to new capacity additions. That meant that new capacity took longer and longer to come on-line—or never came on-line at all. By the time WonderTech's managers were finally ready to add capacity, the symptomatic response had already relieved the pressure, and delivery times had started to fall. Thus their long-term plan for building capacity apparently failed them each time. "Let's wait a little longer before building," they said, "to make sure the demand is there."

In effect, there was a horserace going on between the two responses. Over time, the symptomatic response became more rapid, while the fundamental response became more sluggish. The net effect was that gradually the "disgruntled customer" response assumed more and more of the burden for controlling delivery times.

As delivery times steadily worsened, WonderTech's customer base evolved toward customers who were less sensitive to poor delivery service. That meant they were more sensitive to price. Such customers are less loyal and easily lured away by competitors offering lower prices. WonderTech was drifting into the vulnerable position of being a low-quality, low-price supplier, in a market which they had pioneered.

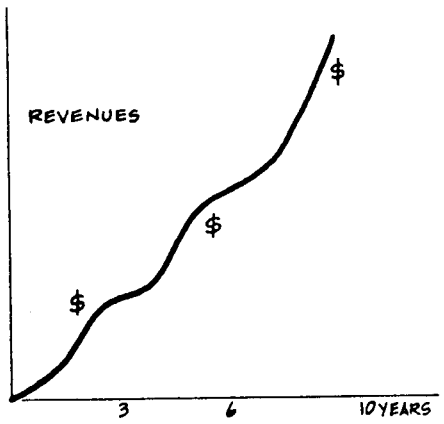
WonderTech's fate could have been reversed. There was a point of leverage in the structure: the firms' original commitment to an eight-week delivery time. In the shifting the burden structure, the first thing a systems thinker looks for is what might be weakening the fundamental response. In this case, the firm had a *delivery time standard*—eight weeks—that obviously never meant a great deal to the financially preoccupied top managers.

After three years, the actual operating standard to which manufacturing had become accustomed was about ten weeks. Over time, as delivery problems returned, the standard continued to drift. No one thought much about it, least of all top management. When they

wanted to know if additional capacity was needed, they would check with manufacturing, which reinforced the eroding standard throughout the organization.

As it happened, the *second* marketing and sales vice president periodically relayed his customers' dissatisfaction with poor deliveries to the management team. His counterpart in manufacturing acknowledged that they occasionally got behind their backlogs, but only when their capacity was inadequate. But the top managers said, "Yes, we know it's a problem, but we can't rush into major investments unless we're certain demand will be sustained." They didn't realize that demand would never be sustained until they made the investment.

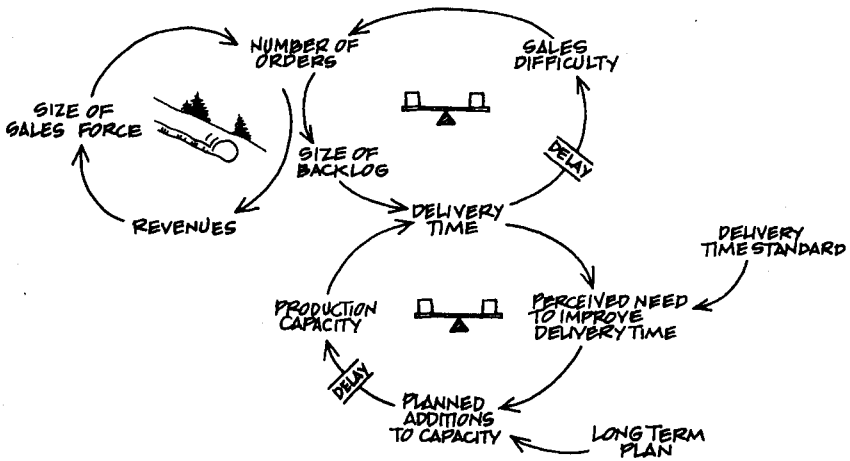
We will never know for certain what might have happened if the company had held tight to its original goal and continued to invest aggressively in manufacturing capacity. But simulations based on this structure (combining limits to growth and shifting the burden) and on actual sales figures have been conducted in which the delivery time standard is not allowed to erode. In these simulations, sales continue to grow rapidly throughout the ten years, although there are still periodic plateaus. Delivery time fluctuates, but does not drift upward and the delivery time standard is constant at eight weeks. WonderTech now realizes its growth potential. At the end of the ten years, sales are many times higher than in the original case.[3]



The original sales and marketing vice president had grasped these problems intuitively. He argued from the outset that WonderTech was assessing its factory capacity all wrong. "We only compare

capacity to the number of orders we *have*," he said, "instead of the potential volume of orders that we *would* have if we were operating at our best." Unfortunately, the VP's arguments were interpreted as excuses for poor sales performance, and his insights went unheeded. It didn't help that he had no way, conceptually, to explain his thinking. Had he been able to describe the systems archetypes, perhaps more people would have grasped what seemed intuitive to him.

In fact, the subtle dynamics of WonderTech confirm an intuition of many experienced managers: that it is vital to hold to critical performance standards "through thick and thin," and to do whatever it takes to meet those standards. The standards that are most important are those that matter the most to the customer. They usually include product quality (design and manufacture), delivery service, service reliability and quality, and friendliness and concern of service personnel. The systemic structure at WonderTech converts this management intuition into an explicit theory, which shows how eroding standards and sluggish capacity expansion can undermine the growth of an entire enterprise. The complete structure comes from integrating limits to growth and shifting the burden:



As shown here, the two structures overlap, sharing one balancing process—where disgruntled customers reduce their orders due to long delivery times. The same balancing circle that diverts attention from adding capacity (in shifting the burden) also keeps sales from expanding (in limits to growth). Whether the "disgruntled customer"

circle becomes dominant depends on how the firm responds when delivery times are long. If standards are allowed to drift, the firm's response is weakened and "the burden shifts" to the disgruntled customers. In other words, the company unwittingly becomes addicted to the limiting of its own growth.

CHOOSING BETWEEN SELF-LIMITING OR SELF-SUSTAINING GROWTH

The systemic structure underlying WonderTech explains many complex situations where companies that were once growing rapidly and were highly successful fail mysteriously. In fact, this structure is another systems archetype called growth and underinvestment, a bit more complicated than the two previous archetypes. This archetype operates whenever a company limits its own growth through underinvestment. Underinvestment means building less capacity than is really needed to serve rising customer demand. You can recognize growth and underinvestment by the failure of a firm to achieve its potential growth despite everyone's working tremendously hard (a sign of the underinvestment). Usually, there is continuing financial stress—which, ironically, is both cause and consequence of underinvestment. Financial stress makes aggressive investment difficult or impossible, but the financial stress today originates in the underinvestment of the past. If you look closely, you will also see eroding or declining standards, within the company or industry, for "quality." (By quality we mean all the things that matter to a customer, such as product quality, service quality, and delivery reliability). Standards erode, or fail to continually advance with competition, which results in a failure to invest in building capacity to serve customer needs. ("Investing" may mean adding or improving physical capacity, training personnel, improving work processes, or improving organizational structures.) Disgruntled customers then go elsewhere. Or, if there is no elsewhere, as in the case of eroding standards in an entire industry, customers stop asking for what they can't have. Reduced customer demand eliminates the symptoms of unmet demand. It also reduces financial resources to invest in more capacity.

If all this happened in a month, the whole organization or industry would be mobilized to prevent it. It is the gradualness of the eroding goals and declining growth that makes the dynamics of this structure so insidious. This is the structure that underlies the "boiled frog" syndrome discussed in the learning disabilities of Chapter 2. The frog's standards for water temperature steadily erode, and its capacity to respond to the threat of boiling atrophies.

For a single firm such as WonderTech, the result is a slow, steady decline in market share and profitability. For an entire industry, the result is increasing vulnerability to foreign competitors with higher standards, happening so slowly that it's difficult to detect, often masked by "shifting the burden" palliatives such as increased advertising, discounting, "restructuring," or lobbying for tariff protection. In my opinion, the dynamics of eroding goals and underinvestment lie at the heart of the demise, between the mid-1960s and mid-1980s, of many American manufacturing industries, such as steel autos, machine tools, and consumer electronics. In each of these industries, loss of market share to foreign competitors, which was invariably blamed on external factors, had its origins, at least in part, in weak standards for customer satisfaction, underinvestment, and unhappy customers.

There are many examples of growth and underinvestment in service industries as well. Schools which let the quality of their courses slip, until they lose accreditation. Hospitals whose reputation for patient care erodes as old facilities are not upgraded and the staff becomes increasingly overworked. Radio and television stations that cut their reporting budgets and let "happy talk" substitute for in-depth news coverage. One such prominent industry example will be examined in the next chapter—the case of People Express Airlines.

When understood, the growth and underinvestment structure can be a powerful guide for a company trying to create its own future. Jay Forrester tells an interesting story from the early days of the Digital Equipment Corporation. The company started operations in a corner of one floor of an old mill building outside Boston, with about a dozen employees. As a member of Digital's Board of Directors (Digital was founded by several of Forrester's former MIT graduate students), Forrester later persuaded the board to rent the whole football-field-sized floor as soon as the space became available. But that leap in capacity, which seemed outrageous at first, allowed Digital to grow without eroding its standards. A most dramatic experience, Forrester said later, was to come back only six months later and find the entire floor full of people, productively employed. This episode was one of the first for a company that has achieved one of

the finest records of sustained growth in corporate history. For years, Digital maintained a land bank of lots all over New England, so that it had land ready when it wanted to add capacity.

The art of systems thinking lies in being able to recognize increasingly (dynamically) complex and subtle structures, such as that at WonderTech amid the wealth of details, pressures, and cross currents that attend all real management settings. In fact, the essence of mastering systems thinking as a management discipline lies in seeing patterns where others see only events and forces to react to. Seeing the forest as well as the trees is a fundamental problem that plagues all firms, as is illustrated in the next chapter.

8

THE ART OF SEEING THE FOREST *AND* THE TREES

Of all recent U.S. presidents, probably none immersed himself so deeply in the issues facing the nation than Jimmy Carter. Yet, President Carter was widely seen as a relatively ineffective leader, leaving office with a 22 percent approval rating, the lowest of any president since the end of World II, including Richard Nixon.[1]

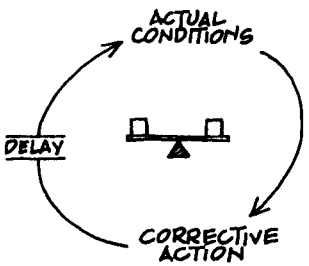
Jimmy Carter was a victim of complexity. Carter's thirst to know about issues firsthand left him drowning in details, without a clear perspective on those details. But, in fact, was Carter really that different from most contemporary leaders, in either the public or private sector? How many CEOs today can stand and give a fifteen-minute speech that lays out a compelling explanation of the systemic causes of an important issue, and the high- and low-leverage strategies for dealing with that issue?

We all know the metaphor of being able to "step back" far enough from the details to "see the forest for the trees." But, unfortunately, for most of us when we step back we just see "lots of trees." We pick our favorite one or two and focus our attention and efforts for change on those.

APPENDIX 2: SYSTEMS ARCHETYPES[1]

BALANCING PROCESS WITH DELAY

Structure:



Description: A person, a group, or an organization, acting toward a goal, adjusts their behavior in response to delayed feedback. If they are not conscious of the delay, they end up taking more corrective action than needed, or (sometimes) just giving up because they cannot see that any progress is being made.

Early Warning Symptom: "We thought we were in balance, but then we overshot the mark." (Later, you may overshoot in the other direction again.)

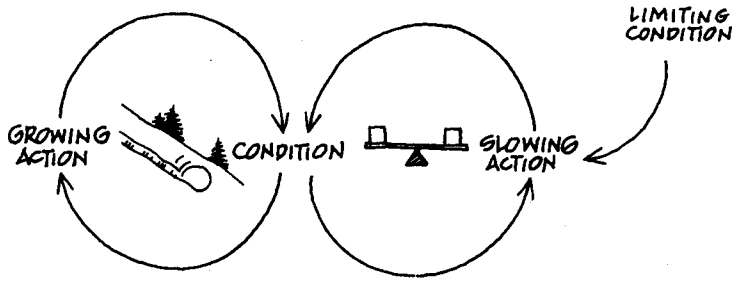
Management Principle: In a sluggish system, aggressiveness produces instability. Either be patient or make the system more responsive.

Business Story: Real estate developers keep building new properties until the market has gone soft—but, by then, there are already enough additional properties still under construction to guarantee a glut.

Other Examples: A shower where the hot water responds sluggishly to changes in the faucet positions; production/distribution glut and shortage cycles (such as that of the beer game); cycles in production rates and in-process inventory due to long manufacturing cycle times; the Tiananmen Square massacre, in which the government delayed its reaction to protest, and then cracked down unexpectedly hard; sudden, excessive stock market soars and crashes.

LIMITS TO GROWTH

Structure:



Description: A process feeds on itself to produce a period of accelerating growth or expansion. Then the growth begins to slow (often inexplicably to the participants in the system) and eventually comes to a halt, and may even reverse itself and begin an accelerating collapse.

The growth phase is caused by a reinforcing feedback process (or by several reinforcing feedback processes). The slowing arises due to a balancing process brought into play as a "limit" is approached. The limit can be a resource constraint, or an external or internal response to growth. The accelerating collapse (when it occurs) arises from the reinforcing process operating in reverse, to generate more and more contraction.

Early Warning Symptom: "Why should we worry about problems we don't have? We're growing tremendously." (A little later, "Sure there are some

problems, but all we have to do is go back to what was working before." Still later, "The harder we run, the more we seem to stay in the same place.")

Management Principle: Don't push on the reinforcing (growth) process, remove (or weaken) the source of limitation.

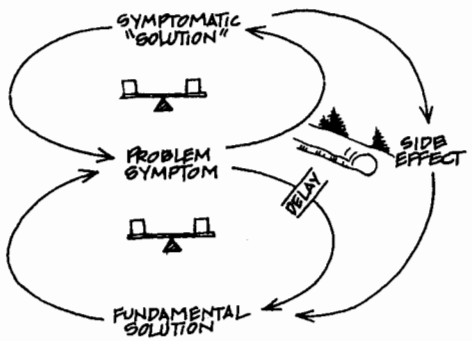
Business Story: A company instituted an affirmative action program, which grew in support and activity as well-qualified minority employees were successfully introduced into work teams throughout the company. But eventually resistance emerged; the new staffers were perceived as not having "earned" their positions over other qualified aspirants. The harder individual teams were pressured to accept the new members, the more they resisted.

Other Examples: Learning a new skill, such as tennis, you make rapid progress early on as your competence and confidence builds, but then you begin to encounter limits to your natural abilities that can be overcome only by learning new techniques that may come "less naturally" at first.

A new startup that grows rapidly until it reaches a size that requires more professional management skills and formal organization; a new product team that works beautifully until its success causes it to bring in too many new members who neither share the work style nor values of the founding members; a city that grows steadily until available land is filled, leading to rising housing prices; a social movement that grows until it encounters increasing resistance from "nonconverts"; an animal population that grows rapidly when its natural predators are removed, only to overgraze its range and decline due to starvation.

SHIFTING THE BURDEN

Structure:



Description: A short-term "solution" is used to correct a problem, with seemingly positive immediate results. As this correction is used more and more, more fundamental long-term corrective measures are used less and less. Over time, the capabilities for the fundamental solution may atrophy or become disabled, leading to even greater reliance on the symptomatic solution.

Early Warning Symptom: "Look here, this solution has worked so far! What do you mean, there's trouble down that road?"

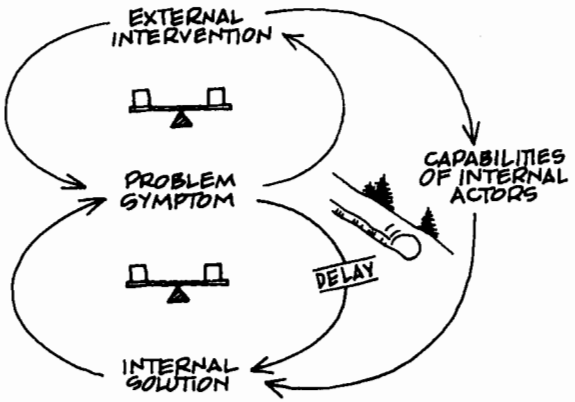
Management Principle: Focus on the fundamental solution. If symptomatic solution is imperative (because of delays in fundamental solution), use it to gain time while working on the fundamental solution.

Business Story: A dramatic new circuit board technology can be used to develop unique functionality and cost savings in a great many new product applications, but it can also be substituted for existing boards in current products. Salespeople can try to sell to "specialty customers" who appreciate the special properties of the technology and will eventually design new products which exploit it fully (the "fundamental solution") or sell to "commodity customers" who do not care about its special properties and will simply substitute it for other boards (the "symptomatic solution"). Given management pressures to meet quarterly sales targets, salespeople sell to whoever is ready to buy, which usually will be commodity customers since there are more of them and delays in the selling cycle are shorter. Over time, the dramatic new technology fails to develop a loyal customer base and becomes subject to the price and margin pressures that characterize commodity products.

Other Examples: Selling more to existing customers rather than broadening the customer base (The "ATP case" from Chapter 12); paying bills by borrowing, instead of going through the discipline of budgeting; using alcohol, drugs, or even something as benign as exercise to relieve work stress and thereby not facing the need to control the workload itself; and any addiction, anywhere, to anything.

SPECIAL CASE: SHIFTING THE BURDEN TO THE INTERVENOR

Structure:



One area where shifting the burden structures are so common and so pernicious that it warrants special notice is when outside "intervenors" try to help solve problems. The intervention attempts to ameliorate obvious problem symptoms, and does so so successfully that the people within the system never learn how to deal with the problems themselves.

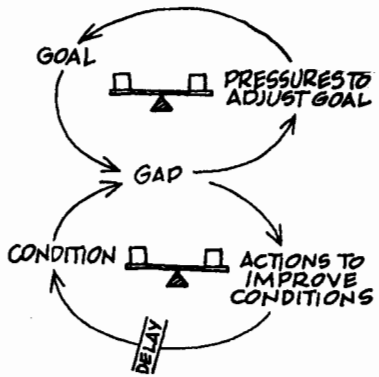
Management Principle: "Teach people to fish, rather than giving them fish." Focus on enhancing the capabilities of the "host system" to solve its own problems. If outside help is needed, "helpers" should be strictly limited to a one-time intervention (and everyone knows this in advance) or be able to help people develop their own skills, resources, and infrastructure to be more capable in the future.

Business Story: An innovative insurance company was committed to the concept of independent local offices that would call on headquarters staff only for occasional help. Initially the concept worked well, until the industry went through a crisis. Facing sudden severe losses, the local offices called in the more experienced central management for help in rewriting rate structures—a process which took months. Meanwhile, the local managers focused their attention on managing the crisis. The crisis was resolved, but the next time rate structures were called into question, the local offices had lost some of their confidence. They called in the central managers as "insurance." After several years of this behavior, the local offices found themselves without underwriters who could manage rate structure changes independently.

Other Examples: Dependence on outside contractors instead of training your own people. Numerous forms of government aid that attempt to solve pressing problems only to foster dependency and need for increasing aid: welfare systems that foster single-family households; housing or job training programs that attract the needy to cities with the best programs; food aid to developing countries which lowers deaths and increases population growth; social security systems that reduce personal savings and encourage the breakup of the extended family.

ERODING GOALS

Structure:



Description: A shifting the burden type of structure in which the short-term solution involves letting a long-term, fundamental goal decline.

Early Warning Symptom: "It's okay if our performance standards slide a little, just until the crisis is over."

Management Principle: Hold the vision.

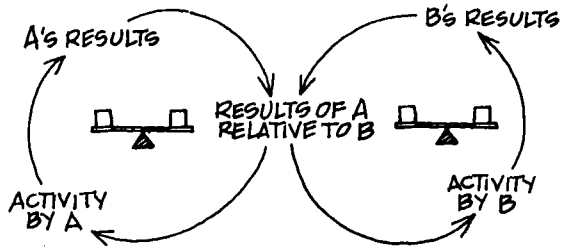
Business Story: A high-tech manufacturer finds itself losing market share, despite a terrific product and ongoing improvements. But the firm, oriented toward its design "geniuses," had never gotten production scheduling under control. An outside investigator discovered that customers were increasingly dissatisfied with late schedules, and were turning to competitors instead. The company stood on its record: "We've maintained a consistent 90 percent success in meeting the delivery time quoted to the customer." It therefore looked elsewhere for the problem. However, every time the company begin to slip its schedules, it responded by making the quoted delivery

time a little longer. Thus, the quoted delivery time to customers was getting lengthier, and lengthier, and lengthier . . .

Other Examples: Successful people who lower their own expectations for themselves and gradually become less successful. Firms that tacitly lower their quality standards by cutting budgets rather than investing in developing new higher quality (and perhaps lower cost) ways of doing things, all the while proclaiming their continued commitment to quality. Lowered government targets for "full employment" or balancing the federal deficit. Sliding targets for controlling dangerous pollutants or protecting endangered species.

ESCALATION

Structure:[2]



Description: Two people or organizations each see their welfare as depending on a relative advantage over the other. Whenever one side gets ahead, the other is more threatened, leading it to act more aggressively to reestablish its advantage, which threatens the first, increasing its aggressiveness, and so on. Often each side sees its own aggressive behavior as a defensive response to the other's aggression; but each side acting "in defense" results in a buildup that goes far beyond either side's desires.

Early Warning Symptom: "If our opponent would only slow down, then we could stop fighting this battle and get some other things done."

Management Principle: Look for a way for both sides to "win," or to achieve their objectives. In many instances, one side can unilaterally reverse the vicious spiral by taking overtly aggressive "peaceful" actions that cause the other to feel less threatened.

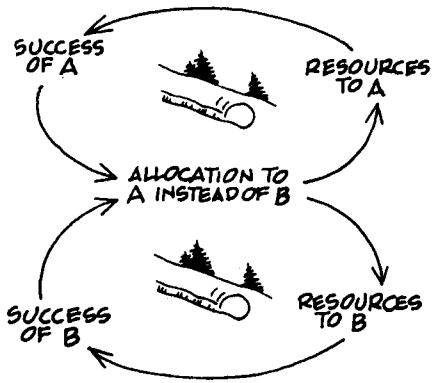
Business Story: A company developed an ingenious design for a stroller, which carried three toddlers at once, yet was light and convenient for travel. It was an immediate hit with families with several young children. Almost

simultaneously, a competitor emerged with a similar product. After several years, jealous of the other company's share of the market, the first company lowered its price by 20 percent. The second company felt a decline in sales, and lowered its price too. Then the first company, still committed to boosting share, lowered its prices still further. The second company reluctantly did the same, even though its profits were beginning to suffer. Several years later, both companies were barely breaking even, and survival of the triple carriage was in doubt.

Other Examples: Advertising wars. Increasing reliance on lawyers to settle disputes. Gang warfare. The breakup of a marriage. Inflating budget estimates: as some groups inflate their estimates, others find themselves doing likewise in order to get "their piece of the pie," which leads to everyone inflating his estimates still further. Battle for the "ear" of the president of a company. And, of course, the arms race.

SUCCESS TO THE SUCCESSFUL

Structure:



Description: Two activities compete for limited support or resources. The more successful one becomes, the more support it gains, thereby starving the other.

Early Warning Symptom: One of the two interrelated activities, groups, or individuals is beginning to do very well and the other is struggling.

Management Principle: Look for the overarching goal for balanced achievement of both choices. In some cases, break or weaken the coupling between

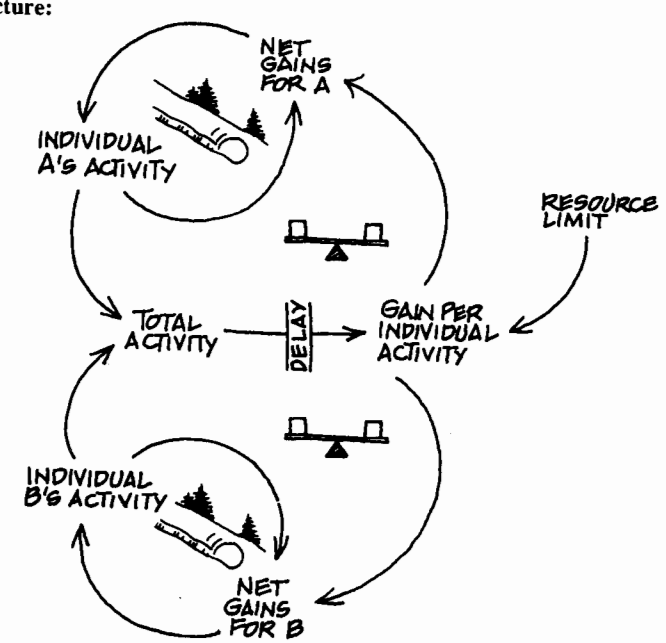
the two, so that they do not compete for the same limited resource (this is desirable in cases where the coupling is inadvertent and creates an unhealthy competition for resources).

Business Story: A manager has two protégés, and wishes to bring both along equally in the firm. However, one of the two ends up getting preferential treatment because the other is out sick for a week. When the second protégé returns to work, the manager feels guilty, and avoids the person, thereby giving still more opportunity to the first protégé. The first protégé, feeling the approval, flourishes, and therefore gets more opportunity. The second protégé, feeling insecure, does less effective work and receives even fewer opportunities, although the two people had equal ability in the beginning. Eventually, the second protégé leaves the firm.

Other examples: Balancing home and work life, in which a worker gets caught working overtime so much that relationships at home deteriorate and it gets more and more "painful" to go home, which, of course, makes the worker even more likely to neglect home life in the future. Two products compete for limited financial and managerial resources within a firm; one is an immediate hit in the marketplace and receives more investment, which depletes the resources available to the other, setting in motion a reinforcing spiral fueling growth of the first and starving the second. A shy student gets off to a poor start in school (perhaps because of emotional problems or an undetected learning disability), becomes labeled a "slow learner," and gets less and less encouragement and attention than his or her more outgoing peers.

TRAGEDY OF THE COMMONS

Structure:



Description: Individuals use a commonly available but limited resource solely on the basis of individual need. At first they are rewarded for using it; eventually, they get diminishing returns, which causes them to intensify their efforts. Eventually, the resource is either significantly depleted, eroded, or entirely used up.

Early Warning Symptom: "There used to be plenty for everyone. Now things are getting tough. If I'm going to get any profit out of it this year, I'll have to work harder."

Management Principle: Manage the "commons," either through educating everyone and creating forms of self-regulation and peer pressure, or through an official regulating mechanism, ideally designed by participants.

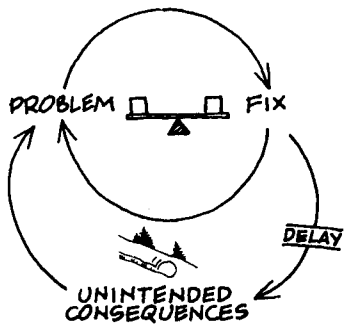
Business Story: Several divisions of a company agreed to share a retail salesforce. Each district manager was initially concerned that the shared salesforce wouldn't give enough attention to his or her particular business, and that volume would decline. One particularly aggressive manager ad-

vised all his account managers to set higher sales targets than were truly needed, so that the salesforce would at least give them the minimum support they needed. The other divisions saw this division pushing for extra work, and decided to employ the same strategy. The new salesforce's managers wanted to accommodate all of their "clients," so they continued to accept the higher requests from the divisions. This created a tremendous overburden of work, lowered performance, and increased turnover. Pretty soon, joining the retail salesforce was only slightly more popular than joining the French Foreign Legion, and each division had to go back to maintaining its own salesforce.

Other Examples: Exhaustion of a shared secretarial pool. Deteriorating reputation for customer service after customers have had to listen to six different salespeople from six different divisions of the same corporation pitching competing products. (The "shared resource" in this case was the firm's positive customer reputation.) A highly successful retail chain gives up on joint sales promotions with manufacturers after being deluged with proposals by enthusiastic manufacturers, or establishes terms for joint ventures that leave little profit for the manufacturers. Depletion of a natural resource by competing companies which mine it. And, of course, all manner of pollution problems from acid rain to ozone depletion and the "greenhouse effect."

FIXES THAT FAIL

Structure:



Description: A fix, effective in the short term, has unforeseen long-term consequences which may require even more use of the same fix.

Early Warning Symptom: "It always seemed to work before; why isn't it working now?"

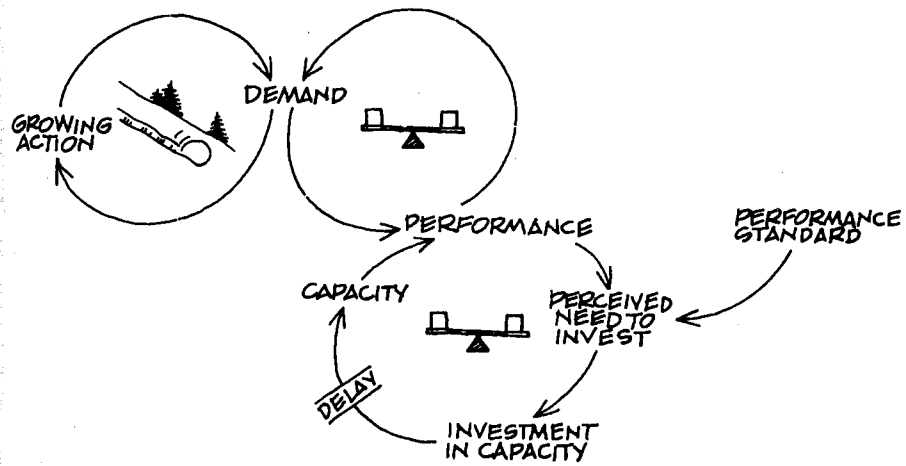
Management Principle: Maintain focus on the long term. Disregard short-term "fix," if feasible, or use it only to "buy time" while working on long-term remedy.

Business Story: A manufacturing company launched a new set of high-performance parts, which were wildly successful at first. However, the CEO was driven by maximizing his ROI, so he deferred ordering expensive, new production machines. Manufacturing quality suffered, which led to a reputation for low quality. Customer demand fell off dramatically over the ensuing year, which depressed returns and made the CEO even more unwilling to invest in new production equipment.

Other Examples: People and organizations who borrow to pay interest on other loans, thereby ensuring that they will have to pay even more interest later. Cutting back maintenance schedules to save costs, which eventually leads to more breakdowns and higher costs, creating still more cost-cutting pressures.

GROWTH AND UNDERINVESTMENT

Structure:



Description: Growth approaches a limit which can be eliminated or pushed into the future if the firm, or individual, invests in additional "capacity." But the investment must be aggressive and sufficiently rapid to forestall reduced growth, or else it will never get made. Oftentimes, key goals or

performance standards are lowered to justify underinvestment. When this happens, there is a self-fulfilling prophecy where lower goals lead to lower expectations, which are then borne out by poor performance caused by underinvestment. (This is the Wondertech structure described in Chapter 7.)

Early Warning Symptom: "Well, we used to be the best, and we'll be the best again, but right now we have to conserve our resources and not overinvest."

Management Principle: If there is a genuine potential for growth, build capacity in advance of demand, as a strategy for creating demand. Hold the vision, especially as regards assessing key performance standards and evaluating whether capacity to meet potential demand is adequate.

Business Story: As described in Chapter 8, the People Express Airlines, found itself unable to build service capacity to keep pace with exploding demand. Rather than putting more resources into training or growing more slowly (for example, through raising prices somewhat), the firm tried to "outgrow" its problems. The result was deteriorating service quality and increased competition, while morale deteriorated. In order to keep up with the continued stress, the company relied more and more on the "solution" of underinvesting in service capacity, until customers no longer found flying People Express attractive.

Other Examples: Companies which let service quality or product quality of any sort decline, simultaneously blaming competition or their sales management for not pushing hard enough to maintain sales. People with grand visions who never realistically assess the time and effort they must put in to achieve their visions.

NOTES

CHAPTER 1
"GIVE ME A LEVER LONG ENOUGH...AND SINGLE-HANDED I CAN MOVE THE WORLD"

1. Daniel Yankelovich, *New Rules: Searching for Self-fulfillment in a World Turned Upside Down* (New York: Random House), 1981.
2. I am indebted to my MIT colleague Alan Graham for the insight that basic innovation occurs through the integration of diverse technologies into a new ensemble. See A. K. Graham, "Software Design: Breaking the Bottleneck," *IEEE Spectrum* (March 1982): 43–50; A. K. Graham and P. Senge, "A Long-Wave Hypothesis of Innovation," *Technological Forecasting and Social Change* (1980): 283–311.
3. Arie de Geus, "Planning as Learning," *Harvard Business Review* (March/April 1988): 70–74.

CHAPTER 2
DOES YOUR ORGANIZATION HAVE A LEARNING DISABILITY?

1. Arie de Geus, "Planning as Learning," *Harvard Business Review* (March/April 1988): 70–74.