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SYSTEMS PRINCIPLES FOR LEADERSHIP

by

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Systems Principles for Leadership

- In complex systems obvious solutions often fail to produce intended results -- in fact, often they exacerbate the very problems they are intended to resolve.

- In complex systems, cause and effect are generally not closely related in time and space. As managers, we typically assume they are.

- Complex systems tend to resist attempts to change their behavior. The most common cause of policy resistance is multiple "compensating feedback" relationships that attempt to maintain internal balances despite external interventions.

- Effective policy design requires understanding an organization and its environment as a unified system so as to shift management attention away from the large number of low-leverage policies to the relatively few high-leverage points.

- Such understanding requires an ongoing management education process. The objective of this education is to shift the style of thinking within an organization. In an organization intent upon realizing its creative potential, fostering systems thinking is a chief function of leadership.

I INTRODUCTION

A significant part of the managerial revolution that is sweeping the business world is a growing awareness that the competencies that underlie successful management and successful leadership are different. An extensive study of successful leaders in a wide range of fields led Warren Bennis to conclude that there are four distinct competencies for successful leadership: management of attention, management of meaning, management of trust, and management of self (Bennis 1985). Running through virtually all studies of leadership are common themes. Leaders are visionaries, who see possibilities and orient themselves toward creating rather than maintaining. Leaders foster alignment and commitment. Leaders are teachers, facilitators, "growers" of human beings. Robert Fritz (1985) discusses the "leader as creator," a person whose fundamental orientation in life is "to bring into reality that which never existed before" and to instill this orientation in others.

For the past year-and-a-half, I have been coordinating a research program involving leaders of some of America's most innovative organizations. Many of these companies have been pioneers in advancing more decentralized organizational designs. In many cases, they have developed a sense of purposefulness and a commonality of values that reach deeply into the organization. These leaders are unanimously agreed that vision, alignment, empowerment, commitment and inspiration are the marks of effective leadership in the type of organizations they seek to build. But, we also feel that there are subtler aspects of effective leadership concerned with organizational learning and predominant styles of thinking in the organization.

The subtler skills of leadership involve creating an environment where responsibility and wisdom advance together. It is to little avail to distribute decision-making responsibility broadly throughout an organization if individuals lack the insight to make effective strategic decisions. Vision and alignment will dissipate if people begin to blame one another as soon as problems arise. Enpowerment will wither if success appears to depend upon events and circumstances beyond the

organization's control. Effective leaders in the more democratic organization of the future will not only encourage and inspire people to trust themselves, take risks, and innovate, they will create a learning environment in which the lessons of experience can be distilled and transmitted far more efficiently than in the traditional authoritarian organization.

Bill O'Brien, president of the Hanover Insurance Companies, says that:

> As we move from the traditional authoritarian organization to the vision-oriented, value-driven organization, the skills required of effective leaders will change dramatically. Just as the "pilot's" skills were transformed in moving from the horse and buggy, to the automobile, to the jet airplane, so too must my skills evolve. The effective leader in a traditional work environment is above all else a strategist and decisionmaker. In the type of work environment we are creating at Hanover critical decisions are made throughout the organization. My job is more and more becoming that of a teacher and a coach rather than a decisionmaker.

In particular, we believe that leaders in the future will be increasingly called upon to develop systemic thinking in organizations. Systemic thinking is integrative, synthesizing diverse viewpoints in order to understand the organization as a whole. It is structural thinking, focusing on the structure of interrelationships among marketing, manufacturing, R&D, and finance that determine organizational success.* Systemic thinking deals with "dynamics," showing how short- and long-term consequences of management actions may be different, even in the opposite direction. In short, systemic thinking is "general management" thinking. As organizations distribute general management responsibilities increasingly broadly, the process of developing systemic thinking must be made more orderly and efficient than in the traditional authoritarian organization.

* Fritz (1985), Shandler (1985), and Kiefer (1985) all emphasize the role of leadership to focus attention on underlying structures. Systemic thinking represents the discipline that leads to understanding structure.

But overcoming a lifetime of training in non-systemic ways of thinking is not easy. Most of us have been taught from grammar school to understand problems by isolating symptoms and analyzing the pieces of a system. For most of us, we were never taught how to integrate our understandings of different parts of a system into a larger whole. The Program in Systems Thinking and the New Management Style is exploring how systemic thinking can be developed within the participating organizations. This paper shares some of the initial insights from this program. In particular, it emphasizes developing fluency in basic systems principles and ongoing exposure to "generic structures" as the foundation for management education in systems thinking.

II AN ILLUSTRATION INVOLVING MARKET GROWTH AND CAPACITY EXPANSION

The following example deals with generic dynamics involved in the growth of virtually any type of enterprise. The simple model of growth dynamics serves to illustrate several important characteristics of systems:

- The nature of causality in complex systems
- Policy resistance: the tendency of complex systems to resist attempts to change their behavior through
  - compensating feedback
  - better-before-worse behavior
  - shifting the burden to the intervenor
- Leverage points: the relatively small number of policy changes that can radiate desirable influences throughout a system.

In complex systems, cause and effect are not closely related in time and space. However, when problem symptoms emerge in a system, attention naturally shifts to nearby parts of the system. Declines in marketing effectiveness are assumed to be due to marketing policies and to personnel. Overruns in manufacturing cost cause attention to be focused on production scheduling and purchasing decisions within manufacturing. Delays in new product development lead to increased pressure on engineers and engineering managers. Moreover, once local remedies are applied, it is expected that problems should be solved relatively quickly. However, 30 years of the study of complex social systems suggests that most major

problems are the results of interactions of diverse forces in different parts of a system and arise over extended periods of time. Effective policies are often not obviously related to problem symptoms, and may achieve their benefits only over an extended period.

The following illustration is concerned with how organizations can limit their growth far below potential, and even when achieving growth, may generate considerable instability in financial performance and growth rate. We begin by considering the self-reinforcing "positive" feedback relationships that link demand for a company's product or services with the company's resources to create further demand (feedback loop 1 in Figure 1).* Increases in demand create more revenues for the enterprise, provided there is adequate capacity to serve demand. Increased revenues, in turn, can be invested in resources to generate further demand. Demand-generating resources include marketing and sales personnel, advertising, and new product development. In the growth of any enterprise, this reinforcing process is active.

* Positive and negative feedback loops are the basic structural building block processes in all dynamic systems. Positive loops amplify change through self-reinforcing pressures like those in loop 1 in Figure 1. Negative feedback loops are balancing, goal-seeking structures that respond to change by creating offsetting pressures that attempt to restore variables to their former values. Examples of negative feedback are temperature control systems in building, hiring policies that adjust workforce in a firm toward desired workforce, and the vast array of processes that maintain homeostasis in any complex organism.

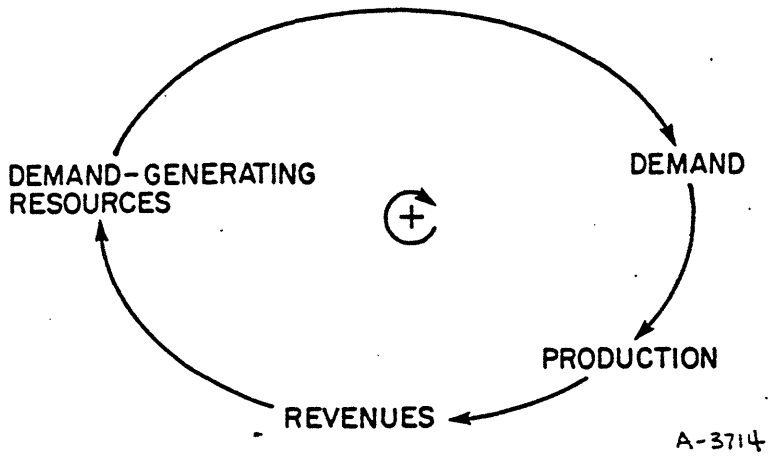


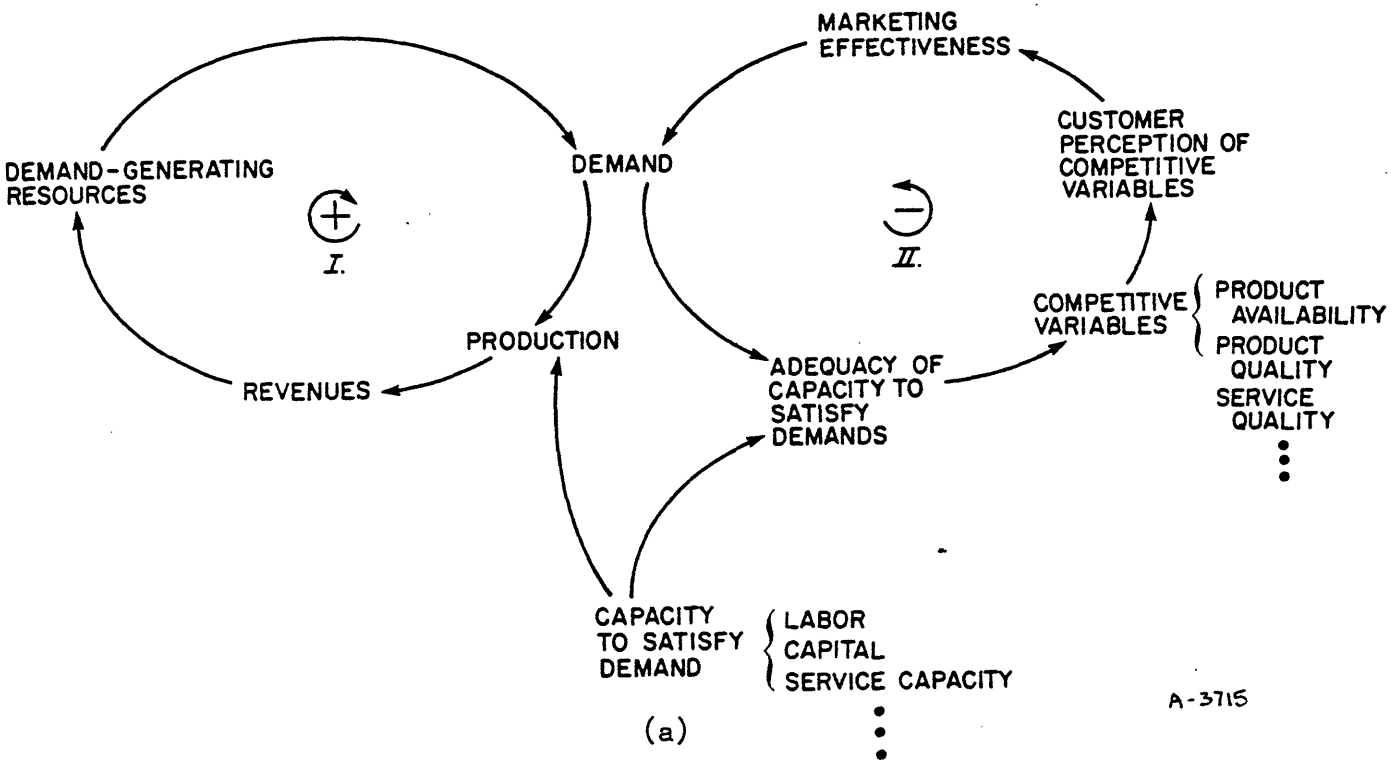
FIGURE 1: A Self-Reinforcing Feedback in Market Expansion

However, sustained growth requires a balanced expansion of demand-generating capacity and capacity to satisfy demand. If growing demands outstrip the enterprise's capacity to satisfy demand, adverse changes in competitive variables will limit growth. For example, demand in excess of production capacity can result in reduced product availability or lower product quality, or both. Similar imbalances can develop with respect to service capacity and service quality, either for a firm in a service industry or for a manufacturing or retailing firm that needs to provide ongoing service to customers who have purchased products in the past.

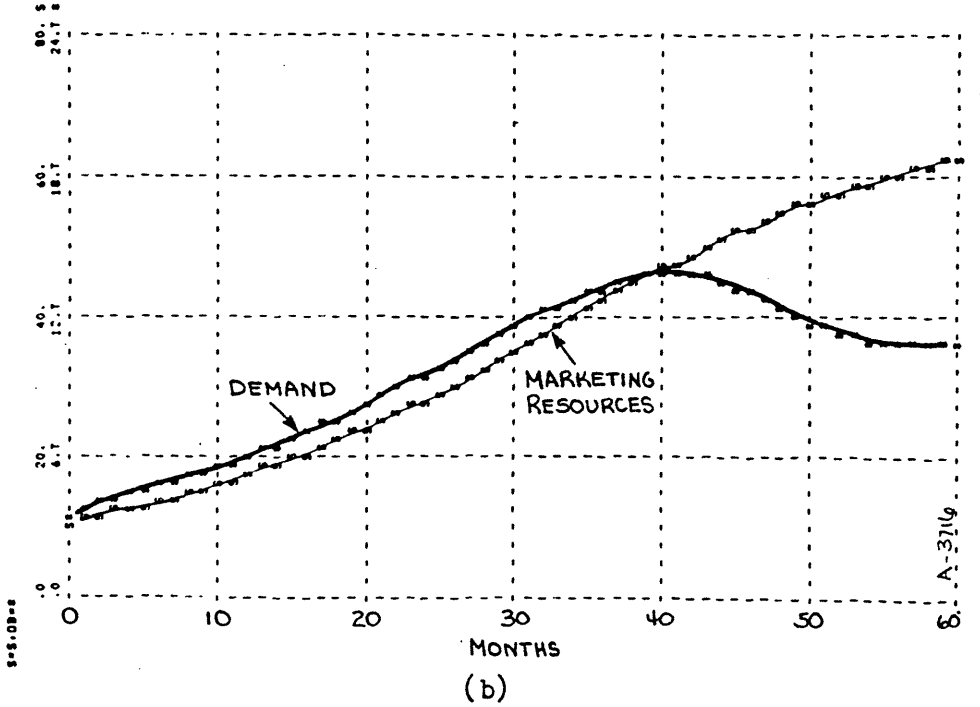
Firms are often unaware of imbalances between ability to create demand and capacity to satisfy demand because the detrimental consequences of imbalances are often not immediately evident. For example, eager salespeople may be promising delivery of new products in delivery times that are impossible to meet, but the customer has no way of knowing. The customer waits until the promised delivery time (which in the case of capital equipment may be several months) before

complaining. Customer dissatisfaction may build for some time before orders are cancelled and word gets out to potential customers that the firm is overextended. Moreover, if lengthening delivery times are building throughout an entire industry, an individual firm's imbalance between demand and capacity to satisfy demand may be masked by eroding industry standards.

Figure 2 shows how resources to generate demand interact with capacity to satisfy demand. The positive feedback loop reinforcing growth of demand-generating resources is coupled with a "negative feedback" loop (loop 2) that shows how inadequate capacity to satisfy demand can limit growth. If capacity is fixed, rising demand will eventually outstrip capacity to satisfy demand, capacity will be stressed, and an erosion in competitive variables will result. However, the effect of this erosion on future demand may not occur immediately, due to delay in market perception and reaction. Thus, demand may continue to grow beyond capacity to satisfy demand. This creates the possibility of overshoot and oscillation in demand, as shown in Figure 2b. It also creates the possibility of the firm reacting to the symptoms of the eventual downturn without understanding their underlying causes.



Feedback Structure: Reinforcing growth of demand-generating resources (loop I) interacts with balancing pressures that limit demand through eroding competitive variables when capacity is inadequate (loop II)



Dynamic Behavior

FIGURE 2: Market Growth Interacting with Fixed Capacity Leads to Overshoot in Demand

III POLICY RESISTANCE

One of the chief characteristics of complex systems is the tendency to resist attempts to change their behavior. Noted biologist Lewis Thomas has said:

> When you are confronted by any complex social system, such as an urban center or a hamster, with things about it that you are dissatisfied with and anxious 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.
>
> (Thomas 1979)

Policy resistance leads to the frustratingly common managerial experience of seeing new policies accomplish short-term improvements only to find old problems reoccurring, of treating problem symptoms only to leave underlying causes unaffected, and of being drawn into a reinforcing spiral of intervention and dependency. One of the most persistent findings of systems research is that problems in complex systems persist despite repeated efforts directed at their solution:

> The world is a complex, interconnected, finite, ecological-social-psychological-economic system. We treat it as if it were not, as if it were divisible, separable, simple, and infinite...
>
> No one wants or works to generate hunger, poverty, pollution, or the elimination of species. Very few people favor arms races or terrorism or alcoholism or inflation. Yet those results are consistently produced by the system-as-a-whole, despite many policies and much effort directed against them.
>
> (Meadows 1982)

In effect, this is the fundamental reason for a systems perspective -- the ineffectiveness of policy changes based on a nonsystemic understanding of problems.

The present illustration points to one of the most common causes of policy resistance -- <u>compensating feedback</u>. Compensating feedback arises from unrecognized balancing mechanisms within a complex system. If symptoms of a problem are part of a balance that a system is seeking to maintain, altering those symptoms simply causes the system to work harder to maintain the balance.

For example, around month 40 in the growth of the firm simulated in Figure 2, demand begins to decline while marketing resources are still expanding. A crisis in marketing effectiveness develops. The average demand per marketing resource (for example, sales per salesperson) is low relative to the growth period. The morale of the sales force is on the decline. Sales commissions are down. Pressure on the marketing and sales group is intensifying. Under such conditions, there are a variety of standard responses of a marketing and sales department intent on boosting marketing effectiveness. These responses might include an increased advertising promotion, cutting price, increasing sales incentives, firing the less productive salespeople, or sales training to upgrade the average effectiveness of the sales force.

Each of these interventions would be designed to improve a problem of falling marketing effectiveness. By their nature, they do not consider the underlying systemic causes of the decline in sales effectiveness, but rather focus on the obvious symptom of low performance. There are many pressures that lead to such "symptomatic" interventions. Even if the management of the marketing and sales group suspected that the source of the problem lay beyond the immediate symptoms, organizational pressures to "do something" about declining performance might still lead to efforts to boost sales effectiveness, even while managers might be inquiring further into the deeper causes of the problem.

The results of intervening to boost marketing effectiveness are shown in Figure 3. In this case, a sales promotion is implemented at month 46, six months after demand stopped growing. The promotion is highly successful -- demand increases 15 percent over three months! However, over the longer term, demand begins to decline again, reaching its prior depressed level 9 months after the promotion was initiated. The same short-term benefit followed by longer-term decline occurs if the firm responds to the crisis with any type of advertising, sales training, increase in sales incentives, or effort to eliminate the less effective salespeople and thereby boost the average effectiveness of the

salesforce. The limitation of all such interventions is that they focus on the symptom of low marketing effectiveness rather than the cause of the symptom. The system compensates for the symptomatic intervention, eventually returning marketing effectiveness to its level before the intervention was undertaken.

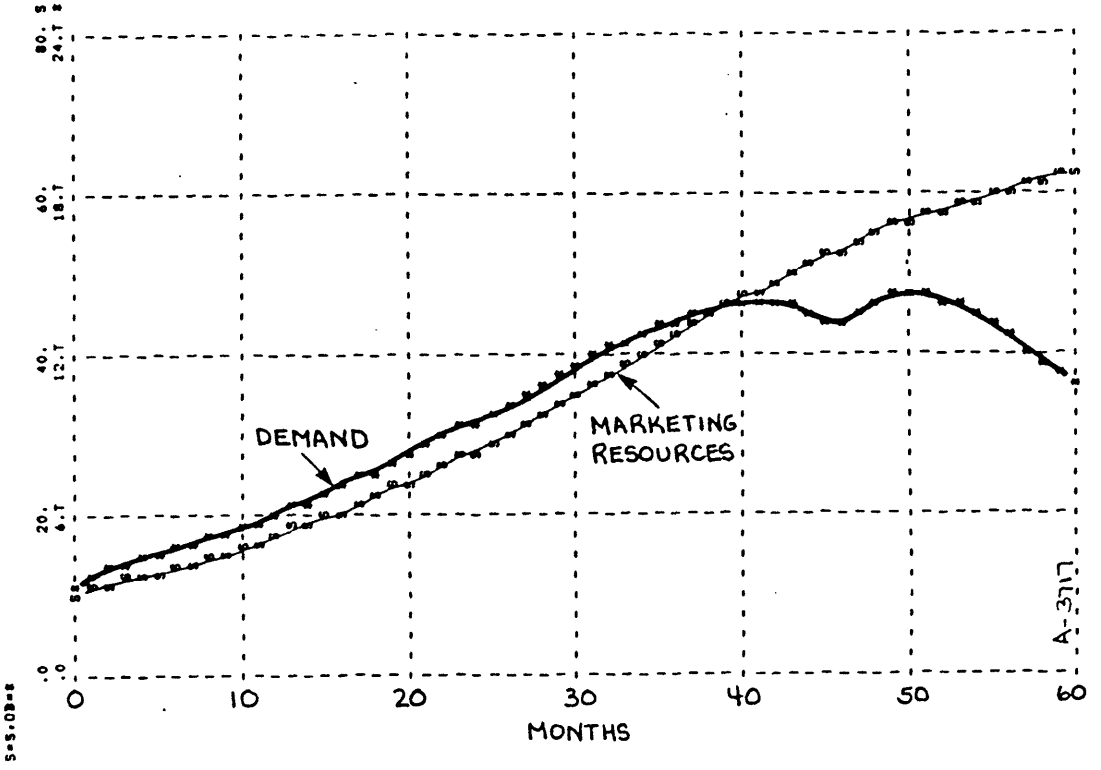


FIGURE 3: A Sales Promotion: boosting marketing effectiveness through a promotion at month 46 leads to a short-term improvement followed by a longer term decline.

Returning to the underlying structure that caused the stagnation in growth, it is easy to see the source of the compensating feedback. The key structure that leads to compensating feedback is the negative feedback loop that interrelates demand and competitive variables such as delivery delay and quality. If a promotion increases marketing effectiveness, demand will increase (Figure 4). But, if demand is already near the firm's capacity to satisfy demand, increased demand will lower the adequacy of capacity, causing further erosion in competitive variables -- for example, lower quality or higher delivery delays. As customers come to perceive this decline in quality or availability, marketing effectiveness will be pushed back down, offsetting the benefits of the initial intervention.

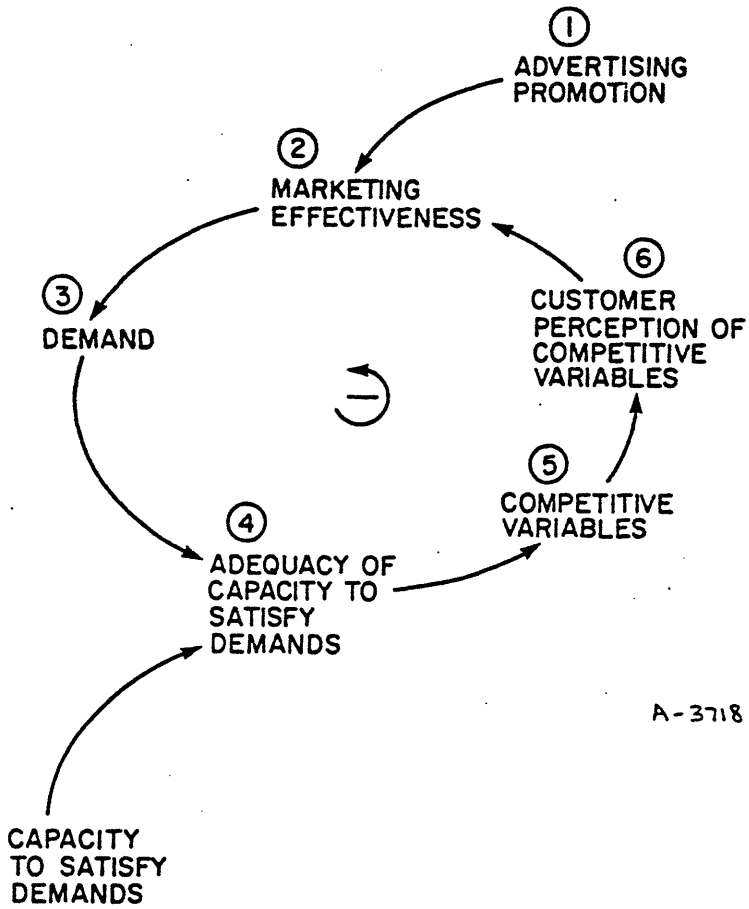


FIGURE 4: Compensating Feedback: The feedback loop linking demand, adequacy of capacity to satisfy demand, and competitive variables compensates for external changes in marketing effectiveness.

Compensating feedback arises because the negative feedback loop through marketing effectiveness is seeking to maintain a balance between demand and capacity to satisfy demand. Over the long-term, no firm can sell more than it can produce. However, in the short-term, it is quite possible for sales to exceed capacity. But, eventually, rising delivery delays, falling product quality, falling service quality, or some combination of the above sends a clear signal to the marketplace. Interventions that succeed in boosting marketing effectiveness when a

firm is already near its capacity to satisfy demand can, at best, produce only temporary improvement.

Examples of compensating feedback abound in the failed interventions of many of the best intentioned social and organizational programs. If the problem is inadequate housing, as the urban problem was frequently viewed in the 1960s, we build more housing. If the problem is excessive costs of gasoline and heating oil to the consumer, we control gas prices, as we did throughout much of the 1970s. If the problem is inadequate national defenses, we invest in further armaments, as we have done for the past 40 years. If the problem is growing government deficits, we raise taxes, as we are about to do in the mid-1980s. In each of these situations, a problem is defined in terms of its most obvious symptoms -- poor housing, high costs of oil and gasoline, inadequate national defenses, rising deficits -- and an action is taken to correct the symptom. The implicit assumption behind each of these actions is that a problem symptom can be controlled by a remedy closely related to the symptom.

In each case, the underlying system that generated the symptom compensates for the intervention. In the 1960s, more people moved to the cities with the housing programs, defeating the intent to provide better housing for a city's low-income residents. In the mid-1970s, artificially low energy prices delayed the transition to non-oil energy sources and undercut incentives for conservation, thereby keeping energy prices high through limiting energy supply and maintaining high energy demand. Attempts to improve U.S. national security through increased arms build-ups have been defeated by increased defense spending by the Soviets. It is very likely that efforts to reduce government deficits through higher taxes will slow economic growth, thereby reducing the tax base and compensating for higher tax rates.

In each of the above examples, the intervention is "successful" if one looks only at its immediate effects. New housing <u>did</u> improve the living conditions of the urban poor, <u>until</u> migration flows adjusted to create more people in need of housing. Energy price controls <u>did</u> reduce

the burden on consumers, until further price increases in imported oil occurred (in 1973, at the time of the first OPEC price increase the U.S. imported 20 percent of its oil, when the second wave of price increases came in 1979, the U.S. imported close to 40 percent of its oil). Building up defense stockpiles does increase perceived national security (and bolster a nation's bargaining position in international negotiations), until the other side's arms increase to offset the advantage. Raising taxes will lower deficit projections, giving national policy makers the satisfaction of having "done something" about the problem. It will probably be a year or more before the effects of higher taxes on economic growth will be felt.

The insidiousness of complex systems stems from the delays in compensating feedback responses. These delays mean that many obvious interventions result in better before worse behavior. Just as the interventions to boost marketing effectiveness in the simple example above did raise demand in the short-term, so too are there inevitably many ways to ameliorate problem symptoms in the short-term. Only over the longer term does the system respond. The multiplicity of short-term fixes is a great pitfall for political decision making, both in the public sector and in corporations.

Because the connection between short- and long-term responses is often unrecognized, intervenors can get drawn into a reinforcing spiral of intervention. The longer the delay between short- and long-term response the more likely is the repeated use of an ineffective intervention. Many developing nations have become completely dependent on foreign food aid because the delay between the short-term benefit of foot aid, reduced mortality, and the long-term disbenefit, increased starvation, is 10 to 20 years. Similar dynamics underlie the increasing dependency of cities on federal support, the poor on welfare programs, nations on their military establishment, and of many corporations on their trusted "intervenors" (for example, the designers of sales promotions, the "motivators" of increased sales, or increasingly lucrative sales incentives). The longer an inappropriate intervention is continued, the harder it can be to break the vicious cycle of dependency.

In complex systems, where cause and effect are often not obviously related, there are subtle pressures to shift the burden for maintaining internal balances to the intervenor. What begins as a one-time response to ameliorate a problem symptom becomes an increasingly necessary ongoing activity.

IV HIGH- VERSUS LOW-LEVERAGE POLICY CHANGES

A chief benefit of the systemic viewpoint for policy is aiding in distinguishing high- from low-leverage policy changes. The vast majority of policy changes adopted within organizations or within larger social systems are low-leverage. However, understanding the systemic causes of problems also reveals the possibility for policy changes that do have a long-term beneficial impact on a system. The only problem is that these "high-leverage points" are almost always "non-obvious" -- that is, not closely related in time and space to the obvious symptoms of a problem.

Expanding the simple model of organizational dynamics introduced above provides an illustration of a typical high-leverage policy change. In particular, we will extend the model by examining pressures to vary capacity to satisfy demand. Most corporations engage in long-term planning for the purpose of defining baseline rates of expansion of marketing resources and production- and service capacity. However, planned rates of capacity acquisition are adjusted depending upon current conditions. For example, during periods of low profitability, when incoming demands are easily met, capacity expansion is often postponned. In many firms, the cost and risk involved with major expansions in capacity means that capacity expansion is not aggressive until there are clear indications in terms of rising order backlogs or other concrete measures of excess demand.

Figure 5 shows the feedback structure whereby capacity to satisfy demand can be adjusted in response to pressure from current competitive performance. If adequacy of capacity is stressed by demands growing in excess of current capacity to satisfy those demands, performance of competitive variables erodes (delivery delays rise, or product quality

declines), increasing pressure to add capacity. As new capacity comes on line, the firm is more able to meet demand, thereby restoring competitive variables. The decision to adjust capacity, from this perspective, stems from attempts to control competitive variables relative to standards for competitive performance. (Because capacity adjustment is motivated by attempting to control key competitive variables, it is part of a negative feedback process.)

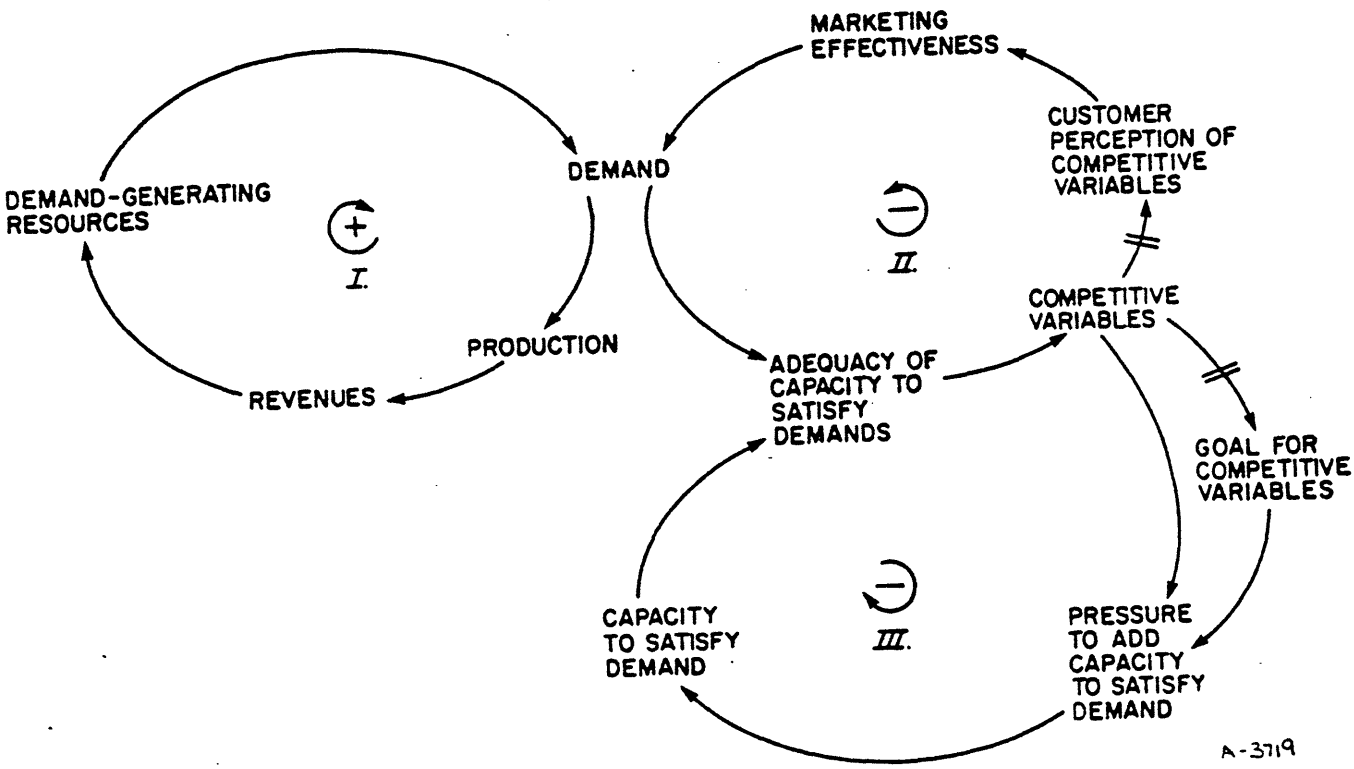


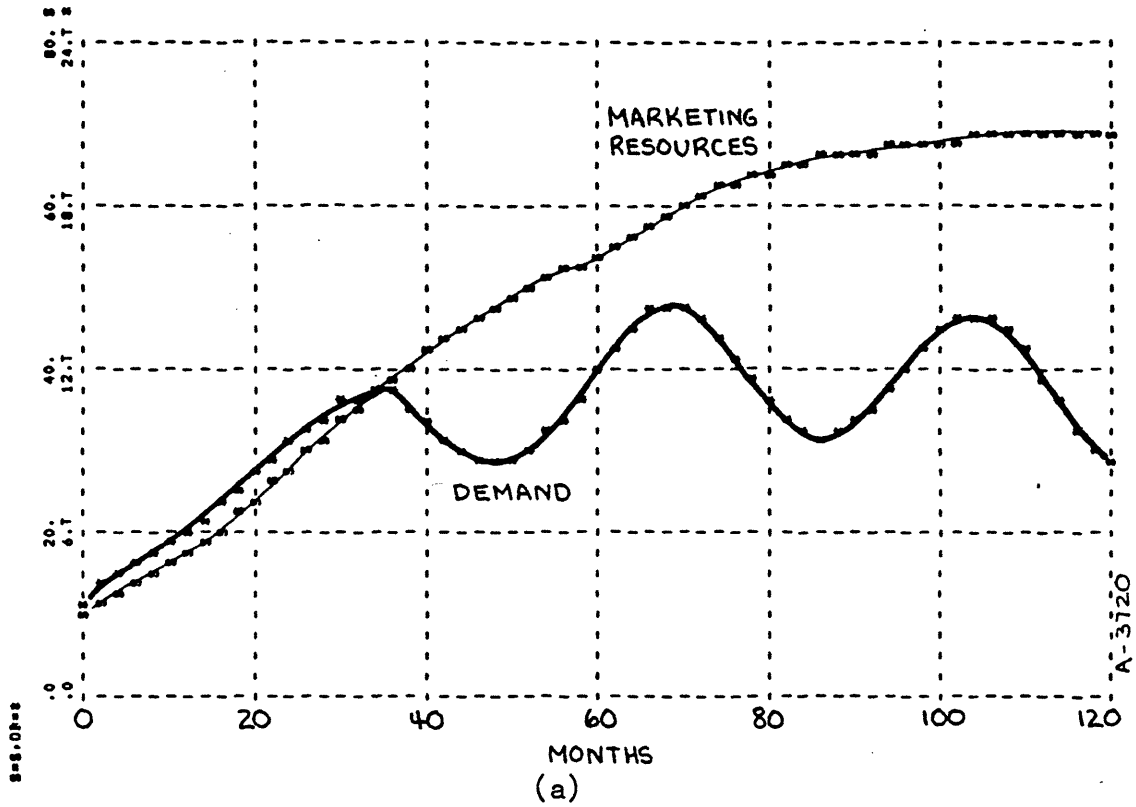
FIGURE 5: Expanded Feedback Structure Involving Market Growth and Capacity Adjustment

The feedback structure in Figure 5 also allows for competitive goals to adjust. For example, if a new firm began with a goal of shipping products in two months but after two years of operation had never shipped a single product in less than two-and-a-half months, goals for delivery delay would tend to adjust. Organizations tend, as do individuals, to

adjust goals in light of past performance. These adjustments are often rationalized as part of the learning process. They are strongly motivated by the psychological stress within an organization consistently failing to achieve desired goals. This goal adjustment process is typically gradual, characterized by incremental shifts, many of which may not even be formally recognized. In Figure 5, goal adjustment is represented by a link from the behavior of competitive variables to the goals for those variables. This causality involves a substantial delay (indicated by "hash marks"), since goals are adjusted only gradually.

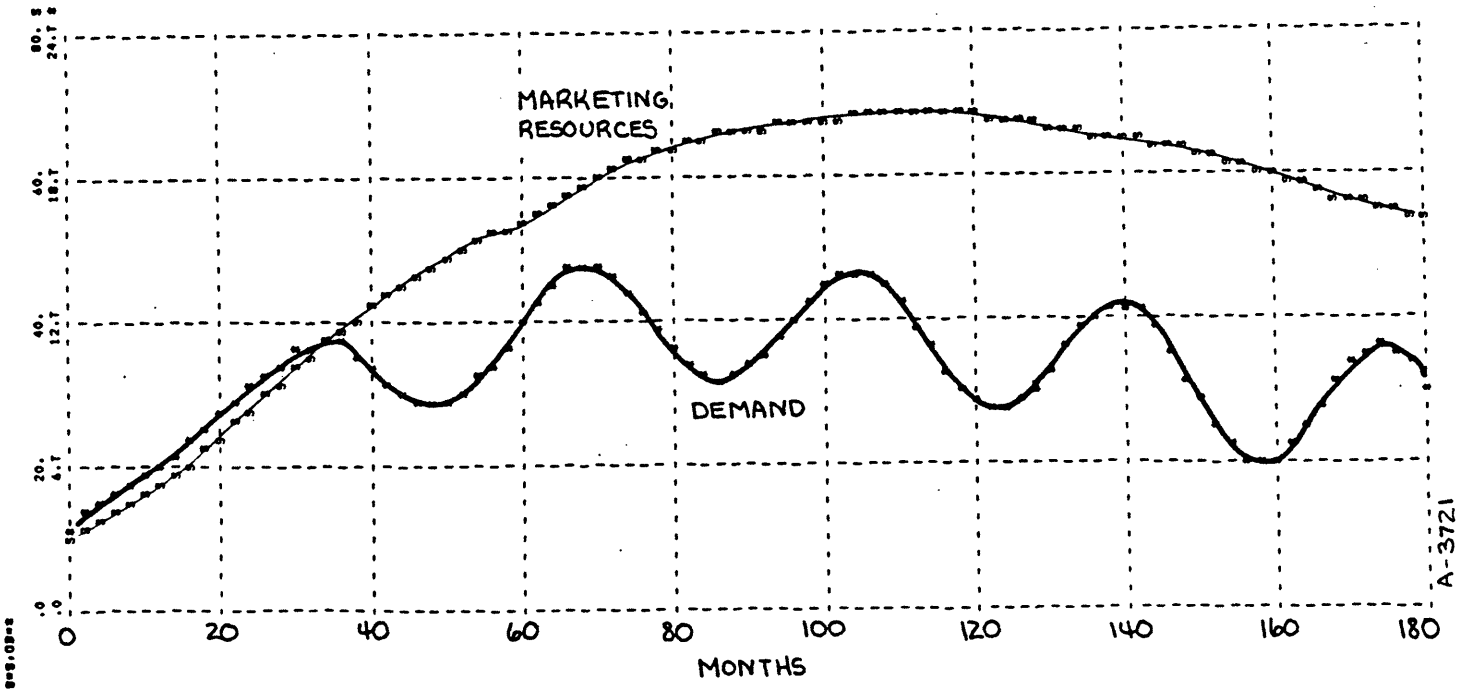
When the more complex structure involving simultaneous adjustments in resources to create demand and capacity to satisfy demand is simulated, the behavior that results is surprising (Figure 6). We have used this generic model of organizational dynamics in training programs for literally thousands of managers. Invariably, most managers expect the structure to generate a pattern of growth interrupted by periodic downturns or plateaus. People expect an unstable growth path because such growth is characteristic of most organizations, and because this structure has the capability of generating cycles, as evident in the preceding section. However, growth is almost always expected because a set of extremely favorable conditions conducive to growth have been assumed. There is no limit on the size of the market. There are no financial constraints on the ability to add capacity. But, even with an unlimited market and no financial constraints on expanding capacity, the firm does not grow. In fact, over the long term, there is a tendency for an initial period of growth to be followed by a gradual stagnation (Figure 6b).*

* In a computer simulation like that shown in Figure 6, numerous numerical assumptions are made regarding the specific length of time delays and the specific aggressiveness of different decisions. Within the structure of interrelationships shown in Figure 5, it is possible to vary these numerical assumptions substantially without altering the basic patterns of behavior shown in Figure 6. Variations in numerical assumptions can result in growth in demand followed by a plateau, or growth followed by decline, or even, if one picks numerical values very carefully, a very modest continued growth. But, given the present structure, there are no plausible sets of numerical values that will result in achieving the growth potential of the firm (see below).



(a)

Demand and Marketing Resources Over 10 Years



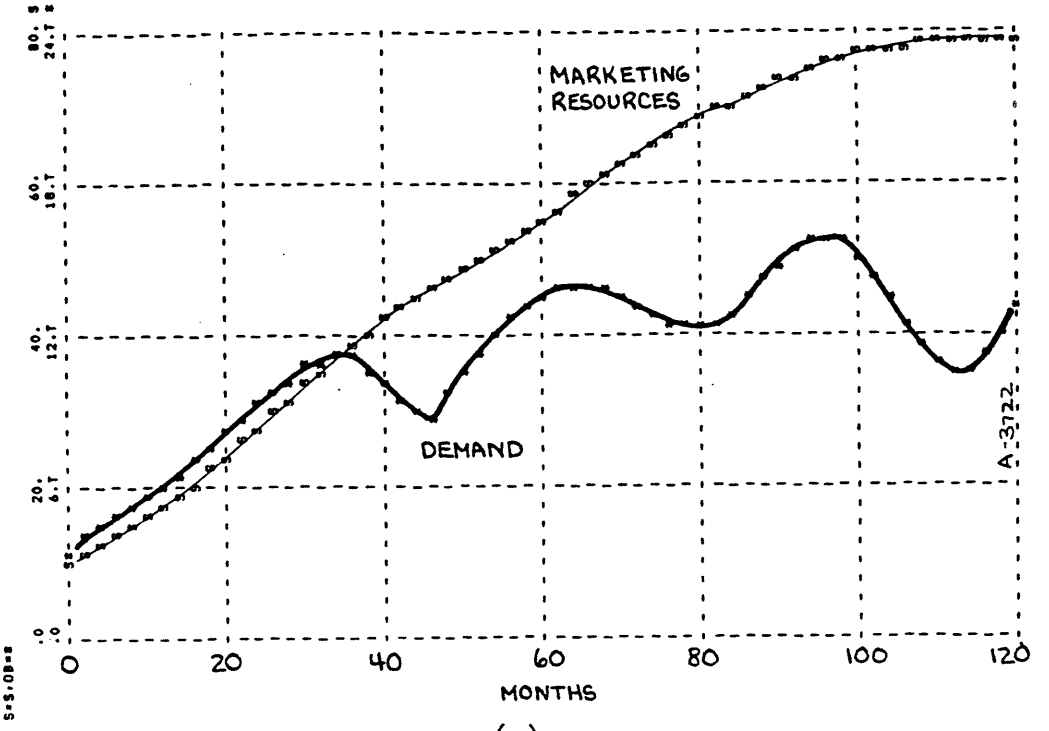
(b)

Demand and Marketing Resources Over 15 Years

FIGURE 6: Simulated Behavior of Structure in Figure 5 Reveals Stagnating Growth

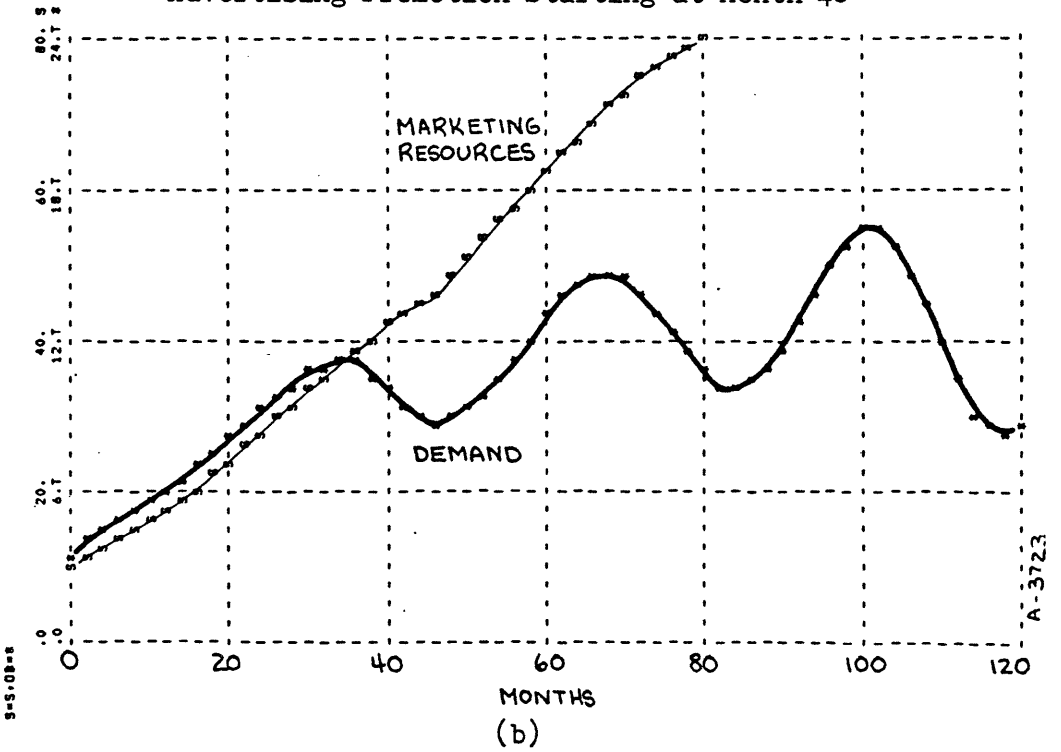
This generic structure of interactions between marketing and capacity expansion shows one of the many ways in which firms can self-limit their own growth. When an organization's growth fails to live up to expectations, there is a strong tendency to blame factors in the environment -- for example, increased competition or inability to finance expansion. All too frequently, firms fail to recognize the leverage that may exist within their own policy structure to limit growth in demand. In particular, managers tend to assume demand as an external variable, particularly when there are demand short-falls. In reality demand patterns are invariably a result of the interaction of external and internal dynamics. If management is limited to studying available statistics, it is virtually impossible to tell the extent to which demand short-falls are externally versus internally caused. In the absence of systemic understanding of how firm policies influence demand, managers consistently underestimate the long-term importance of policies within the firm. When things go wrong, we tend to blame the environment.

The periodic crises of falling demand and marketing effectiveness shown in Figure 6 would tend to call forth the symptomatic interventions described in the preceding section. For example, note that the decline in demand that begins around month 36 presents the same symptoms of falling marketing effectiveness discussed previously. These symptoms would motivate interventions such as sales training or advertising promotions to boost marketing effectiveness, or might be seen as justifying the need for increased investment in marketing resources. However, none of the interventions aimed at the symptom of falling marketing effectiveness will beneficially alter the long-term performance. Figure 7 shows the effects of an advertising promotion to boost marketing effectiveness (begun at month 46) and an increase in the marketing budget leading to more rapid expansion of all aspects of marketing resources (also at month 46). Clearly, neither of these policy changes has any long term beneficial impact. In this structure, policies aimed at the symptoms of eroding marketing effectiveness are inherently low-leverage.



(a)

Advertising Promotion Starting at Month 46



(b)

Increased Budget for Marketing Resources at Month 46

FIGURE 7: Unsuccessful Attempts to Stimulate Growth through Responding to Declines in Marketing Effectiveness

However, there are policy changes which do have the capability of achieving the growth potential of the firm. It is unlikely that these policy changes will be discovered without understanding the dynamics that cause eroding growth. These dynamics are prevalent in a large variety of organizations but are often unrecognized. They are subtle, and beyond the grasp of the simplistic mental models of most managers.

The primary causes of stagnating growth in the present structure lies in how the firm responds to crises in competitive variables. When the performace of key competitive variables is poor, there are always two simultaneous responses. Erosion in competitive variables, such as rising delivery delays or eroding product quality, send internal signals to boost capacity. But, they also send signals to the marketplace. Potential customers learn that the firm is unable to deliver on schedule or is having difficulties meeting product- or service quality promises. Whether or not the firm succeeds in growing vigorously over the long term depends on the relative strength of these two responses. If the firm is sluggish in adjusting its own capacity when its competitive performance erodes, there is an implicit shift of control to the marketplace. If the firm does not adjust its capacity agressively, the customers will make the adjustment themselves, reducing demand and thereby, in effect, correcting the problem of the firm's inadequate capacity.

Whenever capacity is inadequate and competitive variables are declining, there is a narrow "window of opportunity." If a firm fails to aggressively adjust capacity during these times of crisis, the crisis will pass. That is, the poor competitive performance will result in loss of customers, which will lower demand and once again make current capacity adequate to serve a lower demand.

This dynamic adjustment is shown in the behavior of a typical competitive variable, delivery delay, relative to its goal (Figure 8). During the crisis of falling demand and marketing effectiveness centered around month 40 (Figure 6), delivery delay is high. This creates a signal within the organization to expand capacity. But delivery delay

does not stay high indefinitely. It begins to decline and has fallen back to its goal within about one year. By the end of this crisis period, the signals that might motivate further capacity expansion are no longer present, since delivery delay has fallen. The insidiousness of this dynamic lies in the fact that after a relatively brief period of time, "the problem goes away." Delivery delays have fallen and the evidence that capacity is inadequate has disappeared.

The dynamics of interacting capacity expansion and demand adjustments are controlled by the two negative feedback loops shown in Figure 5 (loops 2 and 3). These loops give rise to subtle shifts in control between internal and external forces that determine long term growth. If the firm is not sufficiently aggressive in adjusting its own capacity to satisfy demand, the marketplace will make the adjustment for it. That is, if the internal adjustement to inadequate capacity (loop 3) is weakened, the external adjustment (loop 2) will pick up the slack. These dynamics bear out a fundamental management principle: failure to serve the customer (through aggressively responding to declines in competitive variables that represent disservice to the customer) will undermine the long-term success of the enterprise. We can now see that, from a systemic perspective, this managerial principle arises from the shifting dominance of the two generic responses to inadequate capacity. If the firm's internal response through capacity expansion is dominant (loop 3), demand and supply will be balanced by growing capacity to serve a growing demand. If the external balance is dominant (loop 2), demand and supply will be balanced by limited demand to meet limited capacity. The critical point is that the relative strengths of the two feedback processes is influenced by the firm's own policies.

In the present structure, there is one particular aspect of the firm's internal decision making that is most critical for its ability to expand capacity aggressively. This concerns the way goals for competitive variables adjust to the past performance of those variables. This goal adjustment process, which is common in many firms, can undermine the aggressiveness of capacity expansion by desensitizing management to poor competitive performance. The degree of goal erosion

can be modest, and yet the long-term effects significant. Figure 8 shows that delivery delay goals have eroded only about 30 percent at the peak of the first delivery delay crisis. (Delivery delay goal has risen from 2 to 2.6 months by month 40.) The goal is still well below actual delivery delay at the peak of the crisis. Yet this modest degree of goal erosion is sufficient to slow the acquisition of capacity by reducing the perceived need to aggressively expand capacity.

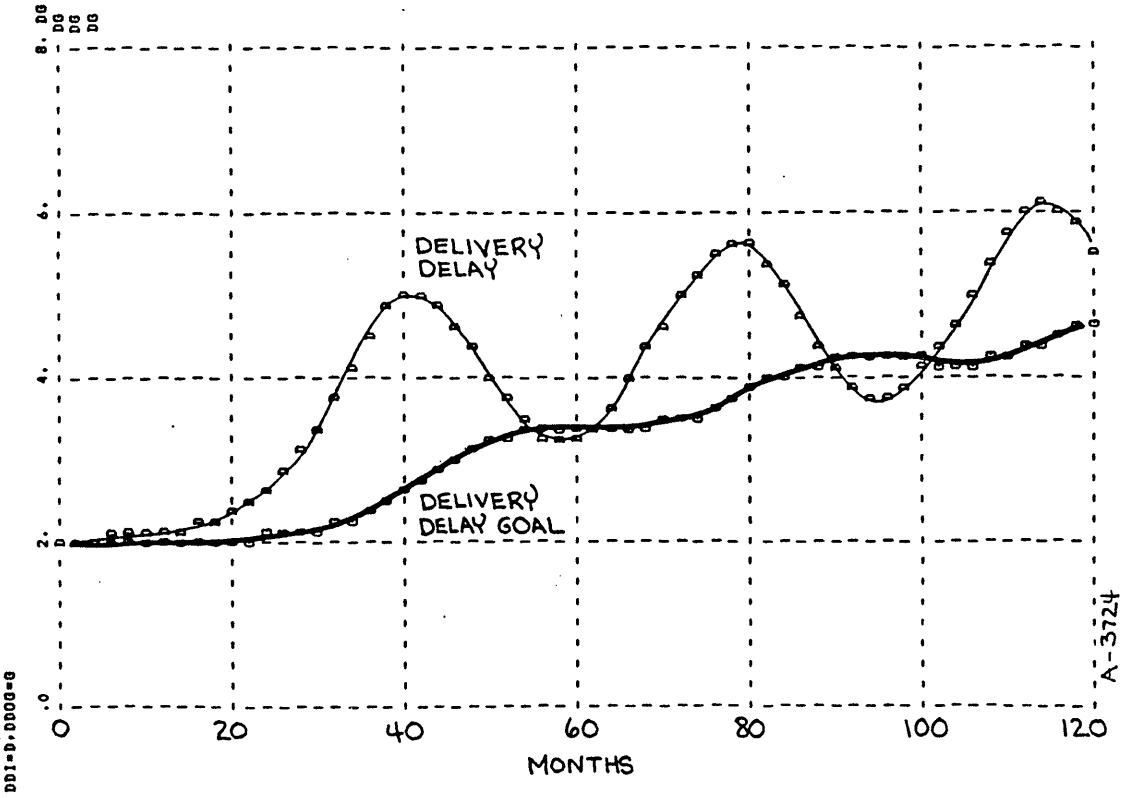


FIGURE 8

Figure 9 shows the growth that results from an explicit policy to not alter goals for competitive variables during times of crisis. This is the only change in structure or parameters relative to the preceding simulation, in which goals for competitive variables were allowed to erode slightly during times of crisis. When goals are not eroded, the potential for growth is realized. After 10 years, the firm's demand is eight times greater than in the eroding goal case; after 15 years, demand is 23 times higher. This dramatic shift in performance highlights a key managerial principle: that eroding goals can undermine the long-term growth potential of an organization.

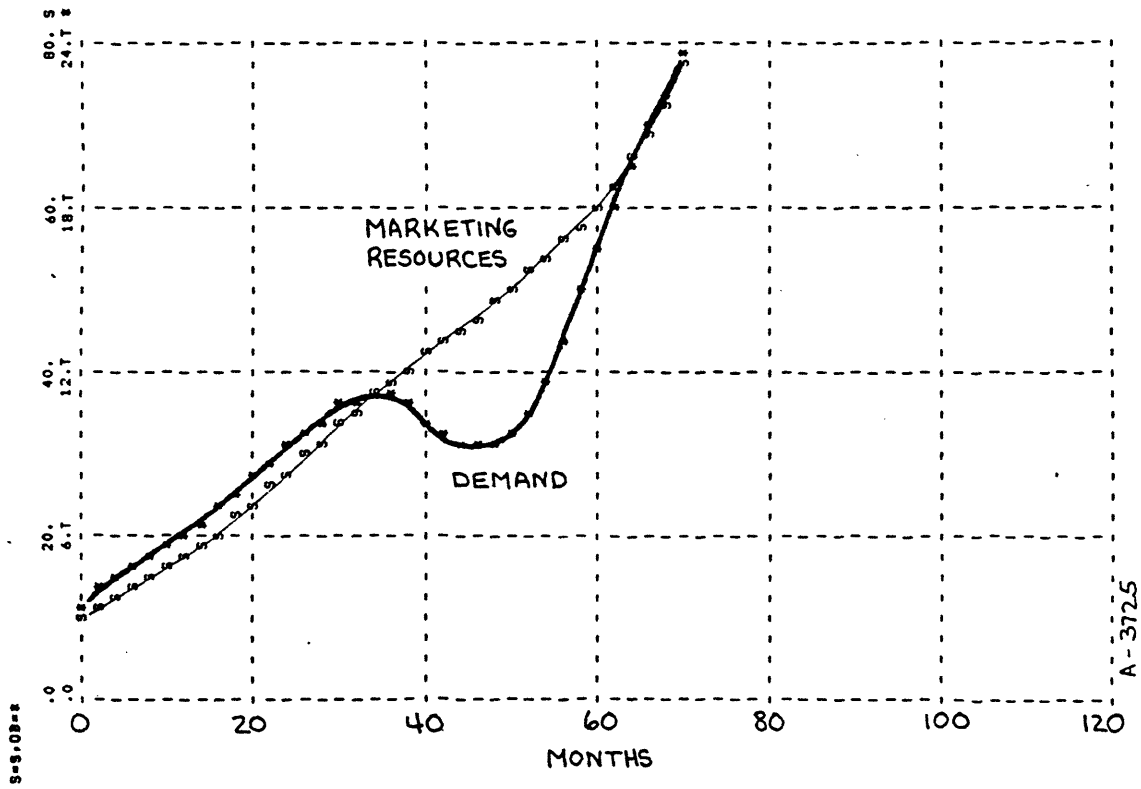


FIGURE 9

The effect of goal setting on long-term growth illustrates the principle of leverage points. Repeated studies of organizational and social systems have shown that there are invariably a small number of policy changes that can have dramatic and enduring effects on performance. However, the most intriguing feature of these high-level

policy changes is that they are very frequently not apparent to the participants in the system. The non-obviousness of leverage points stems from the nature of causality in complex system: namely, that cause and effect are not closely related in time and space. The tendency for all of us to focus on problem symptoms simultaneously leads our focus away from the very actions and policy changes that might have the most impact on these symptoms. Only when managers come to understand the underlying forces that give rise to policy changes do leverage points become apparent.

The systemic perspective illuminates one of the most illusive qualities of great leadership: namely, the intuition to focus attention on the high-leverage policies in a system. While most managers are drawn into a reinforcing struggle to battle crises, a prime function of leadership is to catalyze a deeper understanding. This understanding recontextualizes crises as the by-product of systemic forces. Only by understanding and working with these forces can the creative potential of an organization be realized.

V IMPLEMENTING THE SYSTEMIC PERSPECTIVE

The Program in Systems Thinking and the New Management Style is working with a group of organizations intent upon making systems thinking a practical management tool. The field of general systems theory and systems modeling applied to corporate and public policy issues has been developing for the past 30 years. It holds great potential as a major scientific advance. However, the growth of the field has been limited, by and large, to research and methodological advances. It is time now to begin focusing attention on translating this body of method and principles into an ongoing process of organizational learning and practical tools for decision making.

V.A SYSTEM PRINCIPLES

The first stage in assimilating the systems perspective is to distinguish between problem symptoms and problem causes. Managers continually find themselves drawn into reacting to symtoms, both because of others' expections and by their own inclinations. In most organizations the pressures for management intervention far outweigh the understanding to guide intervention wisely. While the willingness to tackle important problems is a necessary characteristic of effective leadership, the wise leader appreciates that a problem should not be defined by its most obvious symptoms but by its fundamental causes.

Developing a systemic perspective in an organization begins with helping people to appreciate that

- symptoms and causes may not be obviously related, and
- attempts to manipulate problem symptoms in a complex system are rarely successful.

Our experience is that various physical exercises and games can be particularly effective in getting these points across. For many years, we have introduced managers to the systems viewpoint through a role-playing simulation of a production-distribution system. Producers, distributors, wholesalers, and retailers interact in such a way as to produce periodic inventory stock-outs and over-ordering. The participants invariably blame each other and the customers for the instabilities, since this explanation matches the symptoms of build-ups and collapses in incoming orders and in shipments received. It comes as a shock to most participants to discover, when the game is over, that the customer demand was constant and the true causes of instability lie in the very ordering policies that they themselves were following. This game-playing experience begins to build awareness that problem symptoms may be misleading indicators of underlying structural causes.

Another physical exercise created by one of the organizations with which we have worked illuminates the difficulties of management control. The exercise starts with two roller skates connected by springs of different strengths. The "student" is given the relatively simple task

of controlling one roller skate by manipulating the other. The task then gets progressively more challenging as additional roller skates are added to the chain, each connected with springs of varying strengths. By the time there are a half-dozen roller skates, it becomes virturally impossible to control one end of the chain by manipulating the other end. It is then pointed out how much simpler this physical system is than the task facing a manager trying to control local actions through multiple tiers of a management hierarchy.

A gyroscope can make a splendid demonstration of actions producing nonobvious consequences. Because of the complex forces conserving angular momentum, if one side of the gyroscope is pushed upward, it actually moves sideways. If the same point is pushed sideways, it moves downward. Although the simple physical analogy lacks the complexity of the organizational system (in particular, it lacks the time delays that obscure the longer term unintended consequences of many managerial interventions), it makes a strong impression that unintended consequences are a common characteristic of complex systems.

Once people begin to appreciate the nature of cause and effect in complex systems, the next stage in understanding involves applying systems principles like compensating feedback. Compensating feedback arises from unrecognized balancing processes in complex systems. A useful question in discerning potential sources of compensating feedback is to consider the basic balances that are necessary to the health of any particular organization. For example, in a growing enterprise important balances involve capacity to generate demand and capacity to satisfy demand, efforts to develop new products or services and abilities to develop new products or services, rates of labor expansion and capacity to assimilate new people into a coherent culture, and desired rates of capital investment and financial resources for investment. Imbalances in any of these areas produce stresses that will manifest in diverse problem symptoms. Attempting to ameliorate these symptoms will have much less leverage than correcting the underlying imbalance.

For example, in one of the participating companies in the New Management Style Program, the president has been attempting to develop understanding in his organization of the differences between being a "growth-driven" and "quality-driven" company. A growth-driven company, in his terminology, is one that pursues sales growth as its primary objective. When business is going well, it aggressively expands its marketing and sales effort to capitalize on growth opportunities. On the other hand, a quality-driven company places service to the customer in the form of maintaining quality standards as its primary objective. When business conditions are good, the quality-driven organization invests aggressively in its capacity to maintain quality for an expanded business.

This particular company president has been preaching the benefits of being a "quality-driven" organization for some time. The president feels that this message must be understood widely because local managers in his firm have considerable autonomy in pursuing their own policies for growing their parts of the business. Many of the managers in the company undoubtedly take the message to heart -- because the president is a good preacher. But, the president is not satisfied with the degree of implementation of the philosophy. For many, it remains more a philosophy than operating practice. The instincts to seize opportunities for aggressive sales expansion, with little thought toward the longer-term consequences, are deeply ingrained in most entrepreneurial managers.

The management edict, to be a quality-driven company, lacks impact becuase it failes to convincingly explain the underlying imbalances that develop from being a growth-driven company. When new sales grow more rapidly than the capacity to serve new customers, quality declines. Current and potential new customers eventually recognize this falling quality. The additional growth achieved by overly aggressive marketing and sales expansion is eventually compensated for by increasing customer dissatisfaction. The challege to bringing the philosophical ideal more into practice requires deeper understanding of the critical balances necessary for long-term business success.

Understanding compensating feedback also leads to focusing on operating goals, habits, and implicit norms in organizations. Often compensating feedback arises because an attempted organizational change contradicts an implicit norm or operating goal. For example, some "new age" companies that are very successful in promoting an image of health and well-being for their customers have chronic "burnout" problems with their own employees. In one firm, the average tenure of managers was only one or two years because the pace was so frantic. The firm had great difficulties improving this situation despite a variety of corrective measures aimed at the problem. The first was a memo sent to all managers describing the company's commitment to the health and well-being of its employees and concern over the long-term costs, both individually and for the company as a whole, of overwork. This memo had little apparent effect. As the problem continued, a policy of discouraging after-hour work in the company's facilities was adopted. This too had little impact, as many ignored the new policy. The policy was "given more teeth" by closing company facilities at 7 p.m. Not surprisingly, more people took their work home with them in the evening.

The unsuccessfulness of all of the company's efforts to reduce the tendency for overwork and management burnout stemmed from a conflict between this formal corporate goal and an implicit norm in the organization's culture. The goal of employee health and well-being was inconsistent with a norm that personal success stemmed from "breaking through one's own personal limitations." This norm in turn stemmed from the personal philosophy of the company's founder, which he had been fond of preaching for many years. What is important, and was not widely understood by the senior management, was that this philosophy of not being constrained by one's own self-imposed limitations had been translated into an implicit belief that success came from the willingness to continually expand one's personal worklaod. So long as this implicit norm was operative, efforts to "solve the problem" of overwork and burnout were doomed to be ineffective.

A similar example of conflict with established norms and operating goals occurred in an elaborate systems modeling project with a large

capital goods manufacturer. At the end of a study that lasted for more than a year, and that involved much of the key senior leadership in the corporation, it was concluded that the company's production and inventory policies had been responsible for eroding market share. It was determined that the company should maintain a steady production rate during the next business downturn in order to build inventory and improve its product availability while competitors were cutting back. The policy change was a tremendous success. The company actually increased market share during a business downturn and boosted profits substantially. Unfortunately, when the next major business downturn occurred four years later, production practices reverted to the traditional policy of sharp cutbacks and emphasis on controlling inventory costs. The firm continued to lose market share to foreign competitors.

The reason the successful policy failed to take hold was that it conflicted with an operating goal woven deeply into the company's traditions and culture. For many years the president, and later chairman of the board, had preached the virtues of controlling inventory costs. In this particular business the unit cost of inventory is very high and excess inventories can have a dramatic impact on profitability. The fate of production managers who had failed to control inventories during business downturns was legend. For the individual production manager there was no greater fear than to be the person responsible for large inventory costs. Consequently, despite the <u>proven success</u> of the new policy of building inventories during a downturn, this policy conflicted with the traditional practice of successful production managers.

The above examples of thwarted organizational changes illustrate the "structural conflicts" that arise from multiple inconsistent goals (see Fritz 1985, Shandler 1985). New policies involving new goals are often adopted with little recognition of the existence of alternative operating goals and implicit norms.

Conversely, the importance of "aligning" local goals in an organization has become one of the predominant themes of the new management (for example Kiefer and Senge 1984 and Harrison 1984). The

function of effective leadership to establish superordinate visions and values is now widely recognized. From a systemic viewpoint, an overarching vision and value system creates a field in which diverse local goals are brought into greater harmony, thereby reducing the potential for goal conflict. Nonetheless, as has been repeatedly illustrated above, compensating feedback can arise in a great many subtle forms that go beyond conflicts among explicit goals. It would be unwise to assume that simply establishing common vision and values is sufficient to eliminate compensating feedback pressures.

V.B GENERIC STRUCTURES AND MANAGEMENT PRINCIPLES

Assimilating basic system principles begins the process of systemic thinking within an organization. Continuing the process involves an ongoing management education aimed at helping managers to clarify their mental models and bring these models into deeper harmony with reality. (This education process needs to focus on key strategic and operational issues within the organization. It needs to involve a mixture of "classroom" learning and practical application. And, it needs to be integrated with daily decision making.)

The members of the New Management Style Program are working together to develop this type of education within their organizations. The foundation for this process is a growing library of "generic structures" -- relatively simple dynamic models of processes that recur in diverse organizations. The model of interacting market growth and capacity expansion presented above is an example of a generic structure. Like all generic structures, it embodies important management principles by revealing the dynamics that give rise to a principle. The simplest version of the model (Figure 2) embodies the basic principle that "no firm can sell what it doesn't produce over the long term." The expanded version involving capacity adjustments and variable goals for competitive variables embodies the principle that "eroding goals can undermine the long-term growth of an enterprise." Further extensions of this basic structure reveal basic principles of pricing strategy and financial management (see Senge 1984).

In the New Management Style Program we are working to develop generic structures dealing with market development, product development, financial management, human resource management, and organization development. The structures span a broad spectrum of management issues ranging from policies to modulate profit cycles and achieve growth potential to causes of the proliferation of management hierarchy and leadership development. Each structure embodies an important management principle. Our belief is that a relatively modest number of generic structures (well less than 50) should capture a significant portion of the dynamics of organization growth and stability.

Against this backdrop of generic structures it becomes much easier to identify and understand the unique characteristics of individual organizations. Tailoring the generic structures to match the specific circumstances of individual organizations is the second primary activity of the New Management Style Program.

For example, one of the companies in the program is in the property and liability insurance business. When marketing efforts outstrip capacity to satisfy increasing demands, one of the first consequences in the insurance business is erosion in the quality of underwriting. Another unique feature of the insurance business is the delays between sales revenues and the costs associated with settling claims, which creates large cash flows and investment of those cash flows. Together, these two unique characteristics of the insurance industry exacerbate the instability that arises from the generic dynamics of imbalances in a firm's ability to satisfy demand. During periods of rapid growth, large cashflows lead to large investments, the income from which further increases cash flows. Increasing profitability encourages still further expansion (both among existing firms and through the entry of new firms). Overloaded underwriting capacity results in declining underwriting quality, but the costs of this erosion in quality are only felt over the long term, as claim rates start to increase. The result is large profit growth during an upturn and large losses during a downturn, as in fact is characterized the property and liability insurance industry. These dynamics can be understood by modifying the generic model.

Understanding how internal reactions can exacerbate instability can lead to improved policies for dealing with market fluctuations. The chief executive of another of the participating companies in the Program, in a recent address at his stockholder's annual meeting, articulated a policy to reduce the effects of industry cycles on the firm's long-term growth. In particular, he argued that most companies react to short-term pressures on profits in a way that reduces long-term growth:*

> Much has been said and written about American management's propensity to manage for short-term results. And indeed there is an unspoken virtue in management's ability to produce smooth, continuously growing financial results. Investors understandably dislike the uncertainty implicit in wide swings in earnings, particularly when they have no other yardsticks by which to monitor performance.
>
> But the only way to stabilize the output results of a business for unstable growth of demand is to destabilize the execution of long-term programs and the development of the organization. This may minimize short-term variations in earnings but only at the expense of long-term growth and profitability.
>
> (Ray Stata, Analog Devices, Inc., 1985)

Within this firm, a management education program is being developed based upon an extended version of the model of corporate growth presented above. The expanded generic structure, which includes the effects of profitability on capacity expansion and the delays associated with building a loyal customer base, shows that if short-term profit shortfalls lead to reduced capacity expansion, long-term growth and profitability will be below potential. This structure suggests that excessive attention on financial measures of performance may be detrimental to realizing the growth potential of an organization.

In an era when much of American business has drifted toward short-term profit maximization as the sole criterion of organizational success,organizations like the Hanover Insurance Companies, Analog Devices, and the other participants in the New Management Style Program,

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* Address at 1985 Annual Meeting, available from company.

represent a much-needed counterforce. If we fail to develop a long-term systemic perspective to guide private enterprise, it is extremely unlikely that we will succeed in doing so for public policy. Several years ago, the annual report of another of the participating organizations, the Kollmorgen Corporation, argued that American business had a special responsibility to nurture values of freedom and respect for the individual:*

> In a nation drifting slowly away from these concepts of freedom, and individual worth, and ultimate responsibility for one's own destiny, it is ironic that business may be the most free institution left in America. We believe that business must show the way by example to the rest of our institutions.
>
> (Kollmorgen, 1979)

Surely, a similar opportunity presents itself to business to demonstrate the practicality of a systemic perspective for effective leadership.

* 1979 Annual Report, availabe from company.

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