MANAGEMENT SCIENCE
Vol. 32, No. 5, May 1986
Printed in U.S.A.

CENTRAL PROBLEMS IN THE MANAGEMENT OF INNOVATION*

ANDREW H. VAN DE VEN
School of Management, The University of Minnesota, Minneapolis, Minnesota 55455

Innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order. This definition focuses on four basic factors (new ideas, people, transactions, and institutional context). An understanding of how these factors are related leads to four basic problems confronting most general managers: (1) a human problem of managing attention, (2) a process problem in managing new ideas into good currency, (3) a structural problem of managing part-whole relationships, and (4) a strategic problem of institutional leadership. This paper discusses these four basic problems and concludes by suggesting how they fit together into an overall framework to guide longitudinal study of the management of innovation.
(ORGANIZATIONAL EFFECTIVENESS; INNOVATION)

Introduction

Few issues are characterized by as much agreement as the role of innovation and entrepreneurship for social and economic development. Schumpeter's (1942) emphasis on the importance of innovation for the business firm and society as a whole is seldom disputed. In the wake of a decline in American productivity and obsolescence of its infrastructure has come the fundamental claim that America is losing its innovativeness. The need for understanding and managing innovation appears to be widespread. Witness, for example, the common call for stimulating innovation in popular books by Ouchi (1981), Pascale and Athos (1981), Peters and Waterman (1982), Kanter (1983), and Lawrence and Dyer (1983).

Of all the issues surfacing in meetings with over 30 chief executive officers of public and private firms during the past few years, the management of innovation was reported as their most central concern in managing their enterprises in the 1980's (Van de Ven 1982). This concern is reflected in a variety of questions the CEOs often raised.

1. How can a large organization develop and maintain a culture of innovation and entrepreneurship?

2. What are the critical factors in successfully launching new organizations, joint ventures with other firms, or innovative projects within large organizations over time?

3. How can a manager achieve balance between inexorable pressures for specialization and proliferation of tasks, and escalating costs of achieving coordination, cooperation, and resolving conflicts?

Given the scope of these questions raised by CEOs, it is surprising to find that research and scholarship on organizational innovation has been narrowly defined on the one hand, and technically oriented on the other. Most of it has focused on only one kind of organizational mode for innovation—such as internal organizational innovation (Normann 1979), or new business startups (e.g., Cooper 1979)—or one stage of the innovation process—such as the diffusion stage (Rogers, 1981)—or one type of innovation—such as technological innovation (Utterback 1974). While such research has provided many insights into specific aspects of innovation, the encom-

*Accepted by Arie Y. Lewin; received December 10, 1984. This paper has been with the author $3\frac{1}{2}$ months for 1 revision.

0025-1909/86/3205/0590$01.25

passing problems confronting general managers in managing innovation have been largely overlooked.

As their questions suggest, general managers deal with a set of problems that are different from and less well understood than functional managers. We concur with Lewin and Minton's (1985) call for a general management perspective on innovation—one that begins with key problems confronting general managers, and then examines the effects of how these problems are addressed on innovation effectiveness. The purpose of this paper is to present such a perspective on the management of innovation. Appreciating these problems and their consequences provides a first step in developing a research program on the management of innovation.

The process of innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context. This definition is sufficiently general to apply to a wide variety of technical, product, process, and administrative kinds of innovations. From a managerial viewpoint, to understand the process of innovation is to understand the factors that facilitate and inhibit the development of innovations. These factors include ideas, people, transactions, and context over time. Associated with each of these four factors are four central problems in the management of innovation which will be discussed in this paper.

First, there is *the human problem of managing attention* because people and their organizations are largely designed to focus on, harvest, and protect existing practices rather than pay attention to developing new ideas. The more successful an organization is the more difficult it is to trigger peoples' action thresholds to pay attention to new ideas, needs, and opportunities.

Second, *the process problem is managing ideas into good currency* so that innovative ideas are implemented and institutionalized. While the invention or conception of innovative ideas may be an individual activity, innovation (inventing and implementing new ideas) is a collective achievement of pushing and riding those ideas into good currency. The social and political dynamics of innovation become paramount as one addresses the energy and commitment that are needed among coalitions of interest groups to develop an innovation.

Third, there is *the structural problem of managing part-whole relationships*, which emerges from the proliferation of ideas, people and transactions as an innovation develops over time. A common characteristic of the innovation process is that multiple functions, resources, and disciplines are needed to transform an innovative idea into a concrete reality—so much so that individuals involved in individual transactions lose sight of the whole innovation effort. How does one put the whole into the parts?

Finally, the context of an innovation points to *the strategic problem of institutional leadership*. Innovations not only adapt to existing organizational and industrial arrangments, but they also transform the structure and practices of these environments. The strategic problem is one of creating an infrastructure that is conducive to innovation.

After clarifying our definition of innovation, this paper will elaborate on these four central problems in the management of innovation. We will conclude by suggesting how these four problems emerge over time and provide an overall framework to guide longitudinal study of innovation processes.

Innovative Ideas

An Innovation is a new *idea*, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved (Zaltman, Duncan, and Holbek 1973; Rogers

1982). As long as the idea is perceived as new to the people involved, it is an "innovation," even though it may appear to others to be an "imitation" of something that exists elsewhere.

Included in this definition are both technical innovations (new technologies, products, and services) and administrative innovations (new procedures, policies, and organizational forms). Daft and Becker (1979) and others have emphasized keeping technical and administrative innovations distinct. We believe that making such a distinction often results in a fragmented classification of the innovation process. Most innovations involve new technical and administrative components (Leavitt 1965). For example Ruttan and Hayami (1984) have shown that many technological innovations in agriculture and elsewhere could not have occurred without innovations in institutional and organizational arrangements. So also, the likely success of developments in decision support systems by management scientists largely hinges on an appreciation of the interdependence between technological hardware and software innovations on the one hand, and new theories of administrative choice behavior on the other. Learning to understand the close connection between technical and administrative dimensions of innovations is a key part of understanding the management of innovation.

Kimberly (1981) rightly points out that a positive bias pervades the study of innovation. Innovation is often viewed as a good thing because the new idea must be useful—profitable, constructive, or solve a problem. New ideas that are not perceived as useful are not normally called innovations; they are usually called mistakes. Objectively, of course, the usefulness of an idea can only be determined after the innovation process is completed and implemented. Moreover, while many new ideas are proposed in organizations, only a very few receive serious consideration and developmental effort (Wilson 1966; Maitland 1982). Since it is not possible to determine at the outset which new ideas are "innovations" or "mistakes," and since we assume that people prefer to invest their energies and careers on the former and not the latter, there is a need to explain (1) how and why certain innovative ideas gain good currency (i.e., are implemented), and (2) how and why people pay attention to only certain new ideas and ignore the rest. These two questions direct our focus to problems of managing ideas into good currency and the management of attention.

The Management of Ideas

It is often said that an innovative idea without a champion gets nowhere. *People* develop, carry, react to, and modify ideas. People apply different skills, energy levels and frames of reference (interpretive schemas) to ideas as a result of their backgrounds, experiences, and activities that occupy their attention. *People become attached to ideas over time through a social-political process of pushing and riding their ideas into good currency*, much like Donald Schon (1971) describes for the emergence of public policies. Figure 1 illustrates the process.

Schon states that what characteristically precipitates change in public policy is a disruptive event which threatens the social system. Invention is an act of appreciation, which is a complex perceptual process that melds together judgments of reality and judgments of value. A new appreciation is made as a problem, or opportunity is recognized. Once appreciated, ideas gestating in peripheral areas begin to surface to the mainstream as a result of the efforts of people who supply the energy necessary to raise the ideas over the threshold of public consciousness: As these ideas surface networks of individuals and interest groups gravitate to and galvanize around the new ideas. They, in turn, exert their own influence on the ideas by further developing them and providing them with a catchy slogan that provides emotional meaning and energy to the idea.

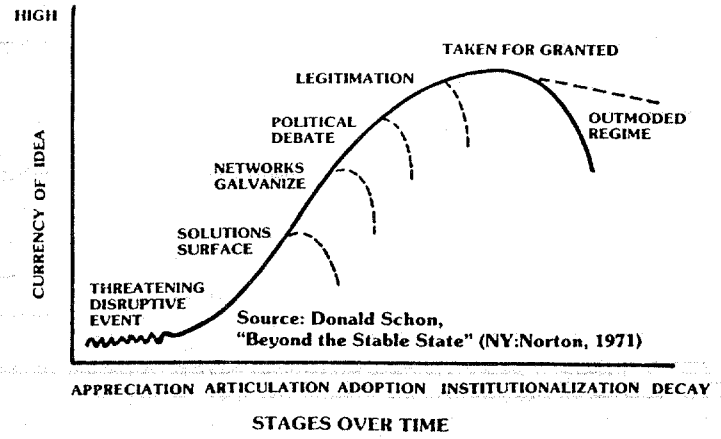

FIGURE 1. Managing Life Cycle of Ideas in Good Currency.

However, Schon indicates that ideas are not potent to change policy unless they become an issue for political debate and unless they are used to gain influence and resources. The debate turns not only on the merits of the ideas, but also on who is using the ideas as vehicles to gain power. As the ideas are taken up by people who are or have become powerful, the ideas gain legitimacy and power to change institutions. After this, the ideas that win out are implemented and become institutionalized—they become part of the conceptual structure of the social system and appear obvious, in retrospect. However, the idea remains institutionalized for only as long as it continues to address critical problems and as long as the regime remains in power.

Schon's description of the stages by which ideas come into good currency is instructive in its focus on the social-political dynamics of the innovation process. The description emphasizes the *centrality of ideas as the rallying point around which collective action mobilizes*—organizational structures emerge and are modified by these ideas. Moreover, it is the central focus on *ideas* that provides the vehicle for otherwise isolated, disconnected, or competitive individuals and stakeholders to come together and contribute their unique frames of reference to the innovation process. Schon (1971, p. 141) states that these stages characteristically describe the process features in the emergence of public policies "regardless of their content or conditions from which they spring." Analogous descriptions of this social-political process have been provided by Quinn (1980, especially p. 104) for the development of corporate strategies, and by March and Olsen (1976) for decision making in educational institutions.

However, there are also some basic limitations to the process that lead to inertia and premature abandonment of some ideas. First, there tends to be a short-term problem orientation in individuals and organizations, and a facade of demonstrating progress. This has the effect of inducing premature abandonment of ideas because even if problems are not being solved, the appearance of progress requires moving on to the next batch of problems. Thus, "old questions are not answered—they only go out of fashion' (Schon 1971, p. 142). Furthermore, given the inability to escape the interdependence of problems, old problems are relabeled as new problems. As a result, and as observed by Cohen, March and Olsen (1972), decision makers have the feeling they are always working on the same problems in somewhat different contexts, but mostly without results.

Except for its use in legislative bodies, the idea of formally managing the socio-political process of pushing and riding ideas into good currency is novel. However, as Huber (1984, p. 938) points out, the decision process is similar to project management and program planning situations. Thus, Huber proposes the adoption of proven

project management and program planning technologies (e.g., PERT, CPM and PPM) for managing the production of ideas into good currency. For example, based upon a test of the Program Planning Model, Van de Ven (1980a, b) concluded that the PPM avoids problems of decision flight and falling into a rut that are present in March and Olsen's (1976) garbage can model of anarchical decision making. This is accomplished by the PPM's three-way matching of phased tasks with different decision processes and with different participants over time in a program planning effort.

A second limitation of the process is that the inventory of ideas is seldom adequate for the situation. This may be because environmental scanning relevant to an issue does not uncover the values and partisan views held by all the relevant stakeholders. Gilbert and Freeman (1984) point out that with the general concept of environmental scanning, current models of strategic decision making gloss over the need to identify specific stakeholders to an issue and to examine their underlying values which provide reasons for their actions. Viewing the process from a game theoretic framework, they state that "effective strategy will be formulated and implemented if and only if each player successfully puts himself or herself in the place of other players and engages in trying to see the situation from the others' viewpoints" (Gilbert and Freeman 1984, p. 4).

A third, and even more basic problem is the management of attention—how do individuals become attached to and invest effort in the development of innovative ideas? Human beings and their organizations are mostly designed to focus on, harvest, and protect existing practices rather than to pave new directions. This is because people have basic physiological limitations of not being able to handle complexity, of unconsciously adapting to gradually changing conditions, of conforming to group and organizational norms, and of focusing on repetitive activities (Van de Ven and Hudson 1985). One of the key questions in the management of innovation then becomes how to trigger the action thresholds of individuals to appreciate and pay attention to new ideas, needs and opportunities.

The Management of Attention

Much of the folklore and applied literature on the management of innovation has ignored the research by cognitive psychologists and social-psychologists about the limited capacity of human beings to handle complexity and maintain attention. As a consequence, one often gets the impression that inventors or innovators have super-human creative heuristics or abilities to "walk on water" (Van de Ven and Hudson 1985). *A more realistic view of innovation should begin with an appreciation of the physiological limitations of human beings to pay attention to nonroutine issues, and their corresponding inertial forces in organizational life.*

Physiological Limitations of Human Beings

It is well established empirically that most individuals lack the capability and inclination to deal with complexity (Tversky and Kahneman 1974; Johnson 1983). Although there are great individual differences, most people have very short spans of attention—the average person can retain raw data in short-term memory for only a few seconds. Memory, it turns out, requires relying on "old friends," which Simon (1947) describes as a process of linking raw data with pre-existing schemas and world views that an individual has stored in long-term memory. Most individuals are also very efficient processors of routine tasks. They do not concentrate on repetitive tasks, once they are mastered. Skills for performing repetitive tasks are repressed in subconscious memory, permitting individuals to pay attention to things other than performance of repetitive tasks (Johnson 1983). Ironically as a result, what most individuals

think about the most is what they will do, but what they do the most is what they think about the least.

In complex decision situations, individuals create stereotypes as a defense mechanism to deal with complexity. For the average person, stereotyping is likely to begin when seven (plus or minus two) objects or digits are involved in a decision—this number being the information processing capacity of the average individual (Miller 1956). As decision complexity increases beyond this point, people become more conservative and apply more subjective criteria which are further and further removed from reality (Filley, House, and Kerr 1976). Furthermore, since the correctness of outcomes from innovative ideas can rarely be judged, the perceived legitimacy of the decision *process* becomes the dominant evaluation criterion. Thus, as March (1981) and Janis (1982) point out, as decision complexity increases, solutions become increasingly error prone, means become more important than ends, and rationalization replaces rationality.

It is generally believed that crises, dissatisfaction, tension, or significant external stress are the major preconditions for stimulating people to act. March and Simon (1958) set forth the most widely accepted model by arguing that dissatisfaction with existing conditions stimulates people to search for improved conditions, and they will cease searching when a satisfactory result is found. A satisfactory result is a function of a person's aspiration level, which Lewin et. al. (1944) indicated is a product of all past successes and failures that people have experienced. If this model is correct (and most believe it is), then scholars and practitioners must wrestle with another basic problem.

This model assumes that when people reach a threshold of dissatisfaction with existing conditions, they will initiate action to resolve their dissatisfaction. However, because individuals unconsciously adapt to slowly changing environments, their thresholds for action are often not triggered while they adapt over time. In this sense, individuals are much like frogs. Although we know of no empirical support for the frog story developed by Gregory Bateson, it goes as follows.

> When frogs are placed into a boiling pail of water, they jump out—they don't want to boil to death.
>
> However, when frogs are placed into a cold pail of water, and the pail is placed on a stove with the heat turned very low, over time the frogs will boil to death.

Cognitive psychologists have found that individuals have widely varying and manipulable adaptation levels (Helson 1948, 1964). When exposed over time to a set of stimuli that deteriorate very gradually, people do not percieve the gradual changes—they unconsciously adapt to the worsening conditions. Their threshold to tolerate pain, discomfort, or dissatisfaction is not reached. As a consequence, they do not move into action to correct their situation, which over time may become deplorable. Opportunities for innovative ideas are not recognized, problems swell into metaproblems, and at the extreme, catastrophes are sometimes necessary to reach the action threshold (Van de Ven 1980b).

These worsening conditions are sometimes monitored by various corporate planning and management information units and distributed to personnel in quantitative MIS reports of financial and performance trends. However, these impersonal statistical reports only increase the numbness of organizational participants and raise the false expectation that if someone is measuring the trends then someone must be doing something about them.

When situations have deteriorated to the point of actually triggering peoples' action thresholds, innovative ideas turn out to be crisis management ideas. As Janis (1982) describes, such decision processes are dominated by defense mechanisms of isolation,

projection, stereotyping, displacement, and retrospective rationalizations to avoid negative evaluations. As a result, the solutions that emerge from such "innovative" ideas are likely to be "mistakes."

Group and Organizational Limitations

At the group and organizational levels, the problems of inertia, conformity, and incompatible preferences are added to the above physiological limitations of human beings in managing attention. As Janis (1982) has clearly shown, groups place strong conformity pressures on members, who collectively conform to one another without them knowing it. Indeed, the classic study by Pelz and Andrews (1966) found that a heterogeneous group of interdisciplinary scientists when working together daily became homogeneous in perspective and approach to problems in as little as three years. Groups minimize internal conflict and focus on issues that maximize consensus. "Group Think" is not only partly a product of these internal conformity pressures, but also of external conflict—"out-group" conflict stimulates "in-group" cohesion (Coser 1959). Consequently, it is exceedingly difficult for groups to entertain threatening information, which is inherent in most innovative ideas.

Organizational structures and systems serve to sort attention. They focus efforts in prescribed areas and blind people to other issues by influencing perceptions, values, and beliefs. Many organizational systems consist of programs, which create slack through efficient repetitive use of procedures believed to lead to success (Cyert and March 1963). But as Starbuck (1983) argues, the programs do not necessarily address causal factors. Instead, the programs tend to be more like superstitious learning, recreating actions which may have little to do with previous success and nothing to do with future success. As a result, the older, larger, and more successful organizations become, the more likely they are to have a large repertoire of structures and systems which discourage innovation while encouraging tinkering. For example, strategic planning *systems* often drive out strategic thinking as participants "go through the numbers" of completing yearly planning forms and review cycles.

The implication is that without the intervention of leadership (discussed below), structures and systems focus the attention of organizational members to routine, not innovative activities. For all the rational virtues that structures and systems provide to maintain existing organizational practices, these "action generators" make organizational participants inattentive to shifts in organizational environments and the need for innovation (Starbuck 1983). It is surprising that we know so little about the management of attention. However, several useful prescriptions have been made.

Ways to Manage Attention

At a recent conference on strategic decision making (Pennings 1985), Paul Lawrence reported that in his consulting practice he usually focuses on what management is *not* paying attention to. Similarly based on his observations in consulting with large organizations, Richard Normann observed that well-managed companies are not only close to their customers, they search out and focus on their *most demanding customers*. Empirically, von Hippel (1977) has shown that ideas for most new product innovations come from customers. Being exposed face-to-face with demanding customers or consultants increases the likelihood that the action threshold of organizational participants will be triggered and will stimulate them to pay attention to changing environmental conditions or customer needs. In general, we would expect that *direct personal confrontations with problem sources* are needed to reach the threshold of concern and appreciation required to motivate people to act (Van de Ven 1980b).

However, while face-to-face confrontations with problems may trigger action thresholds, they also create stress. One must therefore examine the effects of stress on the

innovative process. Janis (1985) outlines five basic patterns of coping with stress, and states that only the vigilance pattern generally leads to decisions that meet the main criteria for sound decision making. Vigilance involves an extended search and assimilation of information, and a careful appraisal of alternatives before a choice is made. Janis proposes that vigilance tends to occur under conditions of moderate stress, and when there may be sufficient time and slack resources to make decisions. Under conditions of no slack capacity or short-time horizons (which produce stress) the decision process will resemble crisis decision-making—resulting in significant implementation errors (Hrebiniak and Joyce 1984).

Argyris and Schon (1982) focus on single loop and double loop learning models for managing attention that may improve the innovation process. In single loop learning, no change in criteria of effective performance takes place. Single loop learning represents conventional monitoring activity, with actions taken based on the findings of the monitoring system. Because it does not question the criteria of evaluation, single loop learning leads to the organizational inertia which Starbuck (1983) indicates must be unlearned before change can occur. Double loop learning involves a change in the criteria of evaluation. Past practices are called into question, new assuptions about the organization are raised, and significant changes in strategy are believed to be possible.

While double loop learning can lead to change, it can also lead to low trust, defensive behavior, undiscussibles, and to bypass tactics. Thus, the management of attention must be concerned not only with triggering the action thresholds of organizational participants, but also of channeling that action toward constructive ends. Constructive attention management is a function of how two other central problems are addressed: part-whole relations and institutional leadership—which we will now discuss.

The Management of Part-Whole Relationships

Proliferation of ideas, people, and transactions over time is a pervasive but little understood characterstic of the innovation process, and with it come complexity and interdependence—and the basic structural problem of managing part-whole relations.

The proliferation of ideas is frequently observed in a single individual who works to develop an innovation from concept to reality. Over time the individual develops a mosaic of perspectives, revisions, extensions, and applications of the initial innovative idea—and they accumulate into a complex set of interdependent options. However, as the discussion of managing ideas into good currency implies, innovation is not an individual activity—it is a collective achievement. Therefore, over time there is also a proliferation of people (with diverse skills, resources, and interests) who become involved in the innovation process. When a single innovative idea is expressed to others, it proliferates into multiple ideas because people have diverse frames of reference, or interpretive schemas, that filter their perceptions. These differing perceptions and frames of reference are amplified by the proliferation of transactions or relationships among people and organizational units that occur as the innovation unfolds. Indeed, management of the innovation process can be viewed as managing increasing bundles of transactions over time.

Transactions are "deals" or exchanges which tie people together within an institutional framework (which is context). John R. Commons (1951), the originator of the concept, argued that transactions are dynamic and go through three temporal stages: negotiations, agreements, and administration. Most transactions do not follow a simple linear progression through these stages. The more novel and complex the innovative idea, the more often trial-and-error cycles of renegotiation, recommitment, and re-administration of transactions will occur. Moreover, the selection of certain kinds of transactions is always conditioned by the range of past experiences and current

situations to which individuals have been exposed. Therefore, people have a conservative bias to enter into transactions with parties they know, trust, and with whom they have had successful experiences. As a consequence, what may start as an interim solution to an immediate problem often proliferates over time into a web of complex and interdependent transactions among the parties involved.

There is an important connection between transactions and organizations. Transactions are the micro elements of macro organizational arrangements. Just as the development of an innovation might be viewed as a bundle of proliferating transactions over time, so also, is there proliferation of functions and roles to manage this complex and interdependent bundle of transactions in the institution that houses the innovation.

The prevailing approach for handling this complexity and interdependence is to divide the labor among specialists who are best qualified to perform unique tasks and then to integrate the specialized parts to recreate the whole. The objective, of course, is to develop synergy in managing complexity and interdependence with an organizational design where the whole is greater than the sum of its parts. However, the whole often turns out to be less than or a meaningless sum of the parts because the parts do not add to, but subtract from one another (Hackman 1984). This result has been obtained not only when summing the products of differentiated units within organizations, but also the benefits member firms derive from associating with special interest groups (Maitland 1983, 1985). Kanter (1983), Tushman and Romanelli (1983), and Peters and Waterman (1982) have shown that this "segmentalist" design logic is severely flawed for managing highly complex and interdependent activities. *Perhaps the most significant structural problem in managing complex organizations today, and innovation in particular, is the management of part-whole relations.*

For example, the comptroller's office detects an irregularity of spending by a subunit and thereby eliminates an innovative "skunkworks" group; a new product may have been designed and tested, but runs into problems when placed into production because R&D and engineering overlooked a design flaw; the development of a major system may be ready for production, but subcontractors of components may not be able to deliver on schedule or there may be material defects in vendors' parts. Typical attributions for these problems include: lack of communication or misunderstandings between scientific, engineering, manufacturing, marketing, vendors and customers on the nature or status of the innovation; unexpected delays and errors in certain developmental stages that complicate further errors and rework in subsequent stages; incompatible organizational funding, control, and reward policies; and ultimately significant cost over-runs and delayed introductions into the market.

Peters and Waterman (1982) dramatized this problem of part-whole relationships with an example of a product innovation which required 223 reviews and approvals among 17 standing committees in order to develop it from concept to market reality. Moreover, they state that

> The irony, and the tragedy, is that each of the 223 linkages taken by itself makes perfectly good sense. Well-meaning, rational people designed each link for a reason that made sense at the time . . . . The trouble is that the total picture as it inexorably emerged . . . captures action like a fly in a spider's web and drains the life out of it. (Peters and Waterman 1982 pp. 18–19).

This example clearly illustrates a basic principle of contradictory part-whole relationships—*impeccable micro-logic often creates macro nonsense*, and vice versa.

Is there a way to avoid having the whole be less than or a meaningless sum of its parts? Perhaps a way is needed to design the whole into the parts, as Gareth Morgan (1983a, b, 1984) has been pursuing with the concept of a *hologram*. He concluded that the

brain, with its incredible complexity, manages that complexity by placing the essential elements of the whole into each of its parts—it is a hologram.

Most organizations, however, are not designed with this logic, but if possible ought to be. The hologram metaphor emphasizes that organization design for innovation is not a discrete event but a process for integrating all the essential functions, organizational units, and resources needed to manage an innovation from beginning to end. It requires a significant departure from traditional approaches to organizing innovation.

Traditionally the innovation process has been viewed as a sequence of separable stages (e.g., design, production, and marketing) linked by relatively minor transitions to make adjustments between stages. There are two basic variations of this design for product innovation. First, there is the technology-driven model where new ideas are developed in the R&D department, sent to engineering and manufacturing to produce the innovation, and then on to marketing for sales and distribution to customers. The second, and currently more popular, design is the customer or need-driven model, where marketing comes up with new ideas as a result of close interactions with customers, which in turn are sent to R&D for prototype development and then to engineering and manufacturing for production. Galbraith (1982) points out that the question of whether innovations are stimulated by technology or customer need is debatable.

> "But this argument misses the point." As reproduced in Figure 2, "the debate is over whether [technology] or [need] drives the downstream efforts. This thinking is linear and sequential. Instead, the model suggested here is shown in Figure [2b]. That is, for innovation to occur, knowledge of all key components is simultaneously coupled. And the best way to maximize communication among the components is to have the communication occur intrapersonally—that is, within one person's mind. If this is impossible, then as few people as possible should have to communicate or interact. (Galbraith 1982, pp. 16–17).

As Galbraith implies, with the hologram metaphor the innovation process is viewed as consisting of iterations of inseparable and simultaneously-coupled stages (or functions) linked by a major ongoing transition process. Whereas the mechanical metaphor of an assembly line of stages characterizes most current views of the innovation process, the biological metaphor of a hologram challenges scholars and practitioners to find ways to place essential characteristics of the whole into each of the parts.

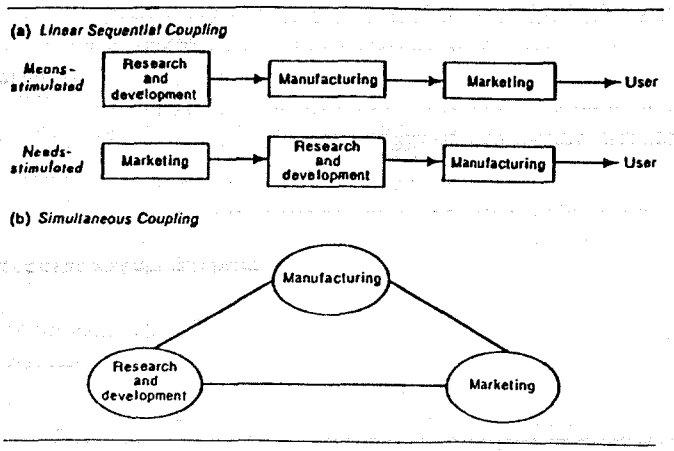

FIGURE 2. Linear Sequential Coupling Compared with Simultaneous Coupling of Knowledge. Source: Jay R. Galbraith (1982).

Although very little is known about how to design holographic organizations, four inter-related design principles have been suggested by Morgan (1985) and others: self-organizing units, redundant functions, requisite variety, and temporal linkage.

First, the hologram metaphor directs attention to identifying and grouping together all the key resources and interdependent functions needed to develop an innovation into one organizational unit, so that it can operate as if it were an *autonomous unit*. (Of course, no organizational unit is ever completely autonomous.) The principle of autonomous work groups has been developed largely by Trist (1981), and is consistent with Thompson's (1967) logical design principle of placing reciprocally-interdependent activities closely together into a common unit in order to minimize coordination costs. By definition, autonomous groups are self-organizing, which implies that management follows the "principle of minimum intervention" (Hrebiniak and Joyce 1984, p. 8). This allows the group to self-organize and choose courses of action to solve its problems within an overall mission and set of constraints prescribed for the unit by the larger organization.

Second, flexibility and a capacity for self-organizing is needed by creating *redundant functions*, which means that people develop an understanding of the essential considerations and constraints of all aspects of the innovation in addition to those immediately needed to perform their individual assignments. Redundant functions does not mean duplication or spare parts as may be implied by the mechanistic metaphor, nor does it eliminate the need for people to have uniquely-specialized technical competencies. It means that all members of an innovation unit develop the capacity to "think globally while acting locally." The principle of redundant functions is achieved through training, socialization, and inclusion into the innovation unit so that each member not only comes to know how his or her function relates to each other functional specialty, but also understands the essential master blueprint of the overall innovation. The former is needed for interdependent action; the latter is essential for survival and reproduction of the innovative effort.

Third, following Ashby's (1956) principle of *requisite variety*, learning is enhanced when a similar degree of complexity in the environment is built into the organizational unit. This principle is a reflection of the fact that any autonomous organizational unit at one level is a dependent part of a larger social system at a more macro level of analysis. Requisite variety means placing critical dimensions of the whole environment into the unit, which permits the unit to develop and store rich patterns of information and uncertainty that are needed in order to detect and correct errors existing in the environment. The principle of requisite variety is not achieved by assigning the task of environmental scanning to one or a few boundary spanners, for that makes the unit dependent upon the "enactments" (Weick 1979) of only one or a few individuals whose frames of reference invariably filter only selective aspects of the environment. Requisite variety is more nearly achieved by making environmental scanning a responsibility of all unit members, and by recruiting personnel within the innovation unit who understand and have access to each of the key environmental stakeholder groups or issues that affect the innovation's development.

Whereas the principles of redundant functions and requisite variety create the slack needed to integrate members of the unit and between the unit and its environment (respectively), the principle of *temporal linkage* integrates parts of time (past, present, and future events) into an overall chronology of the innovation process. While innovations are typically viewed as making additions to existing arrangements, Albert (1984c) proposes another arithmetic for linking the past, present and future. Given a world of scarcity, Albert (1984a, b) notes that the implementation of innovations often results in eliminations, replacements, or transformations of existing arrangements. As a consequence, the management of innovation must also be the management of termina-

tion, and of transitioning people, programs, and investments from commitments in the past toward the future. In common social life, funerals and wakes are used to commemorate and bereave the passing of loved ones and to make graceful transitions into the future. As Albert suggests, there is a need to create funerals, celebrations, and transitional rituals that commemorate the ideas, programs, and commitments falling out of currency in order to create opportunities for ushering in those that must gain good currency for an innovation to succeed.

Institutional Leadership and Innovation Context

Innovation is not the enterprise of a single entrepreneur. Instead, it is a network-building effort that centers on the creation, adoption, and sustained implementation of a set of ideas among people who, through transactions, become sufficiently committed to these ideas to transform them into "good currency." Following holographic principles, this network-building activity must occur both within the organization and in the larger community of which it is a part. *Creating these intra- and extra-organizational infrastructures in which innovation can flourish takes us directly to the strategic problem of innovation, which is institutional leadership.*

The extra-organizational context includes the broad cultural and resource endowments that society provides, including laws, government regulations, distributions of knowledge and resources, and the structure of the industry in which the innovation is located. Research by Ruttan and Hayami (1983) and Trist (1981) suggests that innovation does not exist in a vacuum and that institutional innovation is in great measure a reflection of the amount of support an organization can draw from its larger community. Collective action among institutional leaders within a community becomes critical in the long run to create the social, economic, and political infrastructure a community needs in order to sustain its members (Astley and Van de Ven 1983). In addition, as Aldrich (1979) and Erickson and Maitland (1982) indicate, a broad population or industry purview is needed to understand the societal demographic characteristics that facilitate and inhibit innovation.

Within the organization, institutional leadership is critical in creating a cultural context that fosters innovation, and in establishing organizational strategy, structure, and systems that facilitate innovation. As Hackman (1984, p. 40) points out, "an unsupportive organizational context can easily undermine the positive features of even a well-designed team." There is a growing recognition that innovation requires a special kind of supportive leadership.

> This type of leadership offers a vision of what could be and gives a sense of purpose and meaning to those who would share that vision. It builds commitment, enthusiasm, and excitment. It creates a hope in the future and a belief that the world is knowable, understandable, and manageable. The collective energy that transforming leadership generates, empowers those who participate in the process. There is hope, there is optimism, there is energy (Roberts 1984, p. 3).

Institutional leadership goes to the essence of the process of institutionalization. It is often thought that an organization loses something (becomes rigid, inflexible, and loses it ability to be innovative) when institutionalization sets in. This may be true if an organization is viewed as a mechanistic, efficiency-driven tool. But, as Selznick (1957) argued, an organization does not become an "institution" until it becomes infused with value; i.e., prized not as a tool alone, but as a source of direct personal gratification, and as a vehicle for group integrity. By plan or default, this infusion of norms and values into an organization takes place over time, and produces a distinct identity, outlook, habits, and commitments for its participants—coloring as it does all aspects of organizational life, and giving it a social integration that goes far beyond the formal command structure and instrumental functions of the organization.

Institutional leadership is particularly needed for organizational innovation, which represents key periods of development and transition when the organization is open to or forced to consider alternative ways of doing things. During these periods, Selznick emphasized that the central and distinctive responsibility of institutional leadership is the creation of the organization's character or culture. This responsibility is carried out through four key functions: defining the institution's mission, embodying purpose into the organization's structure and systems, defending the institution's integrity, and ordering internal conflict. Selznick (1957, p. 62) reports that when institutional leaders default in performing these functions, the organization may drift. "A set of beliefs, values and guiding principles may emerge in the organization that are counterproductive to the organization's mission or distinctive competence. As institutionalization progresses the enterprise takes on a special character, and this means that it becomes peculiarly competent (or incompetent) to do a particular kind of work" (Selznick 1957, p. 139). Organization drift is accompanied by loss of the institution's integrity, opportunism, and ultimately, loss of distinctive competence.

Lodahl and Mitchell (1980, pp. 203–204) insightfully apply Selznick's perspective by distinguishing how institutional and technical processes come into play to transform innovative ideas into a set of guiding ideals—see Figure 3. First there are the founding ideals for an innovation or an enterprise, followed by the recruitment and socialization of members to serve those ideas. Leadership and formalization guide and stabilize the enterprise.

When viewed as a set of technical or instrumental tasks, the process is operationalized into setting clear goals or ends to be achieved; establishing impersonal and universal criteria for recruitment, developing clear rules and procedures for learning and socialization; analytical problem solving and decision making; and routinizing activities in order to reduce uncertainty. Institutional processes are very different from this well-known technical approach.

As Figure 3 illustrates, institutional processes focus on the creation of an ideology to support the founding ideals; the use of personal networks and value-based criteria for

INSTITUTIONAL PROCESSES	IDEA	TECHNICAL PROCESSES
CREATION, ELABORATION OF IDEOLOGY	FOUNDING IDEALS	STATEMENT OF ORGANIZATIONAL GOALS
USE OF PERSONAL NETWORKS; SELECTION BASED ON VALUES AND IDEALS	RECRUITMENT	BROAD SEARCH: USE OF UNIVERSALISTIC CRITERIA
FACE-TO-FACE CONTACT WITH FOUNDERS: SHARING RITUALS, SYMBOLS	SOCIALIZATION	RULES AND PROCEDURES LEARNED THROUGH COLLEAGUES
CHARISMATIC, MYTHIC IMAGES (TRANSFORMING)	LEADERSHIP	PROBLEM SOLVING AND CONSENSUS MAKING (TRANSACTIONAL)
IDEALS PARAMOUNT: STRUCTURE TENTATIVE	FORMALIZATION	EARLY ROUTINIZATION; UNCERTAINTY REDUCTION

FIGURE 3. Institutional and Technical Processes. Source: T. Lodahl and S. Mitchell (1980).

recruitment; socialization and learning by sharing rituals and symbols; charismatic leadership; and the infusion of values as paramount to structure and formalize activities.

Lodahl and Mitchell (1980, p. 204) point out that an innovation is an institutional success to the degree that it exhibits authenticity, functionality, and flexibility over time. Authenticity requires that the innovation embodies the organization's ideas; functionality requires that the innovation work; and flexibility requires that the innovation can incorporate the inputs and suggestions of its members. If these tests are met, organizational members will make a commitment to the innovation. In contrast, if institutional skills are not used while technical skills are in operation, the innovation may be an organizational success but an institutional failure. In that case, there will be evidence of drift and disillusionment. Such a result will be characterized by individual self-interest, differentiation, and technical efficiency.

These distinctions between institutional and technical processes have three significant implications for addressing the problems of managing attention, ideas, and part-whole relations discussed in previous sections. These implications draw upon cybernetic principles and the hologram metaphor, as Morgan (1983b, 1984) proposes.

First, organizational members can develop a capacity to control and regulate their own behavior through a process of *negative feedback*, which means that goals are achieved by avoiding not achieving the goal. In other words, deviations in one direction initiate action in the opposite direction at every step in performing an activity so that in the end no error remains. In order for learning through negative feedback to occur, an organization must have values and standards which define the critical limits within which attention to innovative ideas is to focus. Whereas technical processes focus attention on clear-cut goals and targets to be achieved, institutional processes define the constraints to avoid in terms of values and limits. Institutional leadership thus involves a choice of limits (issues to avoid) rather than a choice of ends. As Burgelman (1984, p. 1349) points out, "top management's critical contribution consists in strategic recognition rather than planning." As a result, a space of possible actions is defined which leaves room for innovative ideas to develop and to be tested against these constraints.

Second, whereas single loop learning involves an ability to detect and correct deviations from a set of values and norms, double loop learning occurs when the organization also learns how to detect and correct errors in the operating norms themselves. This permits an institution to adjust and change the ideas considered legitimate or to have good currency.

From an institutional view legitimate error stems from the uncertainty inherent in the nature of a situation. The major problem in dealing with uncertainty is maintaining a balance on organizational diversity and order over time (Burgelman 1984). Diversity results primarily from autonomous initiatives of technical units. Order results from imposing standards and a concept of strategy on the organization. Managing this diversity requires framing ideas and problems so that they can be approached through experimentation and selection. The process of double-loop learning is facilitated by probing into various dimensions of a situation, and of promoting constructive conflict and debate between advocates of competing perspectives. Competing action strategies lead to reconsideration of the organization's mission, and perhaps a reformulation of that mission.

Finally, although technical processes of formalization press to reduce uncertainty, institutional processes attempt to preserve it. Just as necessity is the mother of invention, preserving the same degrees of uncertainty, diversity, or turbulence within an organization that is present in the environment are major sources of creativity and long-run viability for an organization. Embracing uncertainty is achieved by maintain-

ing balance among innovative subunits, each designed according to the holographic principles of autonomous groups, requisite variety, and redundant functions discussed above. Application of these principles results in mirroring the turbulence present in the whole environment into the decision processes and other activities of each of the organization's parts. As a consequence, innovation is enhanced because organizational units are presented with the whole "law of the situation."

Concluding Discussion

Innovation has been defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context. This definition is particularly relevant to the general manager for it applies to a wide variety of technical, product, process, and administrative kinds of innovations that typically engage the general manager. From a managerial viewpoint, to understand the process of innovation is to be able to answer three questions: How do innovations develop over time? What kinds of problems will most likely be encountered as the innovation process unfolds? What responses are appropriate for managing these problems? Partial answers to these questions can be obtained by undertaking longitudinal research which systematically examines the innovation process, problems, and outcomes over time. Undertaking this research requires a conceptual framework to guide the investigation. The main purpose of this paper has been to develop such a framework by suggesting what key concepts, problems, and managerial responses should be the guiding focus to conduct longitudinal research on the management of innovation.

As our definition of innovation suggests, four basic concepts are central to studying the innovational process over time: ideas, people, transactions, and context. Associated with these four concepts are four central problems in the management of innovation: developing ideas into good currency, managing attention, part-whole relationships, and institutional leadership. Although these concepts and problems have diverse origins in the literature, previously they have not been combined into an interdependent set of critical concepts and problems for studying innovation management.

An invention or creative idea does not become an innovation until it is implemented or institutionalized. Indeed by most standards, the success of an innovation is largely defined in terms of the degree to which it gains good currency, i.e., becomes an implemented reality and is incorporated into the taken-for-granted assumptions and thought structure of organizational practice. Thus, a key measure of innovation success or outcome is the currency of the idea, and a basic research question is how and why do some new ideas gain good currency while the majority do not? Based on work by Schon (1971), Quinn (1980), and others, we think the answer requires longitudinal study of the social and political processes by which people become invested in or attached to new ideas and push them into good currency.

But what leads people to pay attention to new ideas? This is the second major problem to be addressed in a research program on innovation. We argued that an understanding of this issue should begin with an appreciation of the physiological limitations of human beings to pay attention to nonroutine issues, and their corresponding inertial forces in organizational life. The more specialized, insulated, and stable an individual's job, the less likely the individual will recognize a need for change or pay attention to innovative ideas. It was proposed that people will pay attention to new ideas the more they experience personal confrontations with sources of problems, opportunities, and threats which trigger peoples' action thresholds to pay attention and recognize the need for innovation.

Once people begin to pay attention to new ideas and become involved in a social-political process with others to push their ideas into good currency, a third

problem of part-whole relationships emerges. A common characteristic in the development of innovations is that multiple functions, resources, and disciplines are necessary to transform innovative ideas into reality—so much so that individuals involved in specific transactions or parts of the innovation lose sight of the whole innovative effort. If left to themselves, they will design impeccable micro-structures for the innovation process that often result in macro nonsense. The hologram metaphor was proposed for designing the innovation process in such a way that more of the whole is structured into each of the proliferating parts. In particular, application of four holographic principles was proposed for managing part-whole relationships: self-organizing groups, redundant functions, requisite variety, and temporal linkage.

However, these holographic principles for designing innovation units simultaneously require the creation of an institutional context that fosters innovation and that links these self-organizing innovative units into a larger and more encompassing organizational mission and strategy. The creation of this macro context for innovation points to the need to understand and study a fourth central problem, which is institutional leadership. Innovations must not only adapt to existing organizational and industrial arrangements, but they also transform the structure and practices of these environments. The strategic problem for institutional leaders is one of creating an infrastructure that is conducive to innovation and organizational learning.

Three cybernetic principles were proposed to develop this infrastructure. First, the principle of negative feedback suggests that a clear set of values and standards are needed which define the critical limits within which organizational innovations and operations are to be maintained. Second, an experimentation-and-selection approach is needed so that the organization develops a capacity for double-loop learning, i.e., learning how to detect and correct errors in the guiding standards themselves. Third, innovation requires preserving (not reducing) the uncertainty and diversity in the environment within the organization because necessity is the mother of invention. Embracing uncertainty can be achieved at the macro level through the principles of requisite variety and redundancy of functions.

It should be recognized that this has been a speculative essay on key problems in the management of innovation. Little empirical evidence is presently available to substantiate these problems, their implications, and proposed solutions. However, the essay has been productive in suggesting a core set of concepts, problems, and propositions to study the process of innovation over time, which is presently being undertaken by a large group of investigators at the University of Minnesota. A description of the operational framework being used in this longitudinal research is available (Van de Ven and Associates 1984). As this research progresses we hope to provide systematic evidence to improve our understanding of the central problems in the management of innovation discussed here.[1]

[1]The author wishes to gratefully recognize the stimulation of ideas for this paper from faculty and student colleagues involved in the Minnesota Innovation Research Program. Helpful comments on earlier drafts of this paper were provided by George Huber, William Joyce, Arie Lewin, Kenneth Mackenzie, and Donald Schon. This research program is supported in part by a major grant from the Organizational Effectiveness Research Programs, Office of Naval Research (Code 4420E), under Contract No. N00014-84-K-0016. Additional research support is being provided by 3M, Honeywell, Control Data, Dayton-Hudson, First Bank Systems, Cenex, Dyco Petroleum, and ADC Corporations.

References

ALBERT, S., "A Delite Design Model for Successful Transitions," in J. Kimberly and R. Quinn (Eds.), *Managing Organizational Transitions*, Irwin, Homewood, Il., 1984a, Chapter 8, 169–191.

———, "The Sense of Closure," in K. Gergen and M. Gergen (Eds.), *Historical Social Psychology*, Lawrence Erlbaum Associates, 1984b, Chapter 8, 159–172.

———, "The Arithmetic of Change," University of Minnesota, Minneapolis, unpublished paper, 1984c.
ALDRICH, H., *Organizations and Environments*, Prentice Hall, Englewood Cliffs, N.J., 1979.
ARGYRIS, C. AND D. SCHON, *Reasoning, Learning, and Action*, Jossey-Bass, San Francisco, 1983.
ASHBY, W. R., *An Introduction to Cybernetics*, Chapman and Hall, Ltd., London, 1956.
ASTLEY, G. AND VAN DE VEN, "Central Perspectives and Debates in Organization Theory," *Admin. Sci. Quart.*, 28 (1983), 245–273.
BURGELMAN, R. A., "Corporate Entrepreneurship and Strategic Management: Insights from a Process Study," *Management Sci.*, 29, 12 (1983), 1349–1364.
COHEN, M. D., J. G. MARCH AND J. P. OLSEN, "A Garbage Can Model of Organizational Choice," *Admin. Sci. Quart.*, 17 (1972), 1–25.
COMMONS, J., *The Economics of Collection Action*, MacMillan, New York, 1951.
COOPER, A., "Strategic Management: New Ventures and Small Business," in D. Schendel and C. Hofer (Eds.), *Strategic Management*, Little, Brown and Company, Boston, 1979.
COSER, L., *The Functions of Social Conflict*, Routledge and Kegan Paul, New York, 1959.
CYERT, R. M. AND J. G. MARCH, *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, N.J., 1963.
DAFT, R. AND S. BECKER, *Innovation in Organization*, Elsezier, New York, 1978.
ERICKSON, B. AND I. MAITLAND, "Healthy Industries and Public Policy," in Margaret E. Dewar (Eds.), *Industry Vitalization: Toward a National Industrial Policy*, Elmsford, N.Y., 1982.
FILLEY, A., R. HOUSE AND S. KERR, *Managerial Process and Organizational Behavior*, Scott Foresman, Glenview, Il., 1976.
GALBRAITH, J. R., "Designing the Innovating Organization," *Organizational Dynamics*, (Winter 1982), 3–24.
GILBERT, D. AND E. FREEMAN, "Strategic Management and Environmental Scanning: A Game Theoretic Approach," presented to the Strategic Management Society, Philadelphia, October 1984.
HACKMAN, J. R., "A Normative Model of Work Team Effectiveness," Yale School of Organization and Management, New Haven, Conn., Research Program on Group Effectiveness, Technical Report #2, 1984.
HELSON, H., "Adaptation-Level as a Basis for a Quantitative Theory of Frames of Reference," *Psychological Rev.*, 55 (1948), 294–313.
———, "Current Trends and Issues in Adaptation-Level Theory," *American Psychologist*, 19 (1964), 23–68.
HUBER, G., "The Nature and Design of Post-Industrial Organizations," *Management Sci.*, 30, 8 (1984), 928–951.
JANIS, I., *Groupthink*, 2nd edition, Houghton Mifflin, Boston, 1982.
———, "Sources of Error in Strategic Decision Making," in J. Pennings (ed.), *Strategic Decision Making in Complex Organizations*, Jossey-Bass, San Francisco, 1985.
JOHNSON, PAUL E., "The Expert Mind: A New Challenge for the Information Scientist," In M. A. Bemmelmans (Ed.), *Beyond Productivity: Information Systems Development for Organizational Effectiveness*, North Holland Publishing, Netherlands, 1983.
KANTER, R., *The Change Masters*, Simon and Schuster, New York, 1983.
KIMBERLY, J., "Managerial Innovation," in Nystrom, P. and W. Starbuck (Eds.), *Handbook of Organizational Design*, Volume 1, Oxford University Press, Oxford, 1981, 84–104.
LAWRENCE, P. AND P. DYER, *Renewing American Industry*, Free Press, New York, 1983.
LEAVITT, H. J., "Applied Organizational Change in Industry: Structural, Technological, and Humanistic Approaches," Chapter 27 in J. March (Ed.), *Handbook of Organizations*, Rand McNally, Chicago, 1965, 1144–1170.
———, "Applied Organizational Change in Industry: Structural, Technological, and Humanistic Approaches," Chapter 25, in J. March (Ed.), *Handbook of Organizations*, Rand McNally, Chicago, 1965, 1144–1170.
LEWIN, ARIE Y., AND JOHN W. MINTON, "Organizational Effectiveness: Another Look, and an Agenda for Research," *Management Sci.*, 32, 5 (May 1986).
LEWIN, K., T. DEMBO, L. FESTINGER, AND P. SEARS, "Level of Aspiration," Chapter 10 in J. McV. Hunt (Ed.), *Personality and the Behavior Disorders*, Vol. 1, Ronald Press, New York, 1944.
LODAHL, T. AND S. MITCHELL, "Drift in the Development of Innovative Organizations," in J. Kimberly and R. Miles (Eds.), *The Organizational Life Cycle*, Jossey-Bass, San Francisco, 1980.
MAITLAND, I., "Organizational Structure and Innovation: The Japanese Case," in S. Lee and G. Schwendiman, *Management by Japanese Systems*, Prager, New York, 1982.
———, "House Divided: Business Lobbying and the 1981 Budget," *Research in Corporate Social Performance and Policy*, 5 (1983), 1–25.
———, "Interest Groups and Economic Growth Rates," *J. Politics*, (1985).
MARCH, JAMES G., "Decisions in Organizations and Theories of Choice," In A. Van de Ven and W. F. Joyce (Eds.), *Perspectives on Organizational Design and Behavior*, Wiley, New York, 1981.

——— AND J. P. OLSEN, *Ambiguity and Choice in Organizations*, Universitetsforlaget, Bergen, 1976.
——— AND H. SIMON, *Organizations*, Wiley, New York, 1958.
MILLER, G. A., "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information," *Psychological Rev.*, 63 (1956), 81–97.
MORGAN, G., "Action Learning: A Holographic Metaphor for Guiding Social Change," *Human Relations*, 37, 1 (1983a), 1–28.
———, "Rethinking Corporate Strategy: A Cybernetic Perspective," *Human Relations*, 36, 4 (1983b), 345–360.
———, "Images of Organizations," York University, Downsview, Ontario, Prepublication manuscript, 1986.
NORMANN, R., *Management for Growth*, Wiley, New York, 1977.
———, "Towards an Action Theory of Strategic Management," in J. Pennings (Ed.), *Strategic Decision Making in Complex Organizations*, Jossey-Bass, San Francisco, 1985.
OUCHI, W., *Theory Z*, Addison-Wesley, Reading, Mass., 1981.
PASCALE, R. AND A. ATHOS, *The Art of Japanese Management*, Warner Books, New York, 1981.
PELZ, D. AND F. ANDREWS, *Scientists in Organizations*, Wiley, New York, 1966.
PENNINGS, J., *Strategic Decision Making in Complex Organizations*, Jossey-Bass, San Francisco, 1985.
PETERS, T. AND R. WATERMAN, *In Search of Excellence: Lessons from America's Best-Run Companies*, Harper and Row, New York, 1982.
QUINN, JAMES BRIAN, *Strategies for Change: Logical Incrementalism*, Irwin, Homewood, Ill., 1980.
ROBERTS, N., "Transforming Leadership: Sources, Process, Consequences," presented at Academy of Management Conference, Boston, August 1984.
ROGERS, E., *Diffusion of Innovations*, 3rd Ed., The Free Press, New York, 1982.
RUTTAN, V. AND HAYAMI, "Toward a Theory of Induced Institutional Innovation," *J. Development Studies*, 20, 4 (1984), 203–223.
SCHON, D., *Beyond the Stable State*, Norton, New York, 1971.
SCHUMPETER, J., *Capitalism, Socialism, and Democracy*, Harper and Row, New York, 1942.
SELZNICK, P., *Leadership in Administration*, Harper and Row, New York, 1957.
SIMON, H. A., *Administrative Behavior*, Macmillan, New York, 1947.
STARBUCK, W., "Organizations as Action Generators," *Amer. J. Sociology*, 48, 1 (1983), 91–115.
TERRYBERRY, S., "The Evolution of Organizational Environments," *Admin. Sci. Quart.*, 12 (1968), 590–613.
TRIST, E., "The Evolution of Sociotechnical Systems as a Conceptual Framework and as an Action Research Program," in A. Van de Ven and W. Joyce (Eds.), *Perspectives on Organization Design and Behavior*, Wiley, New York, 1981, 19–75.
TUSHMAN, M. AND E. ROMANELLI, "Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation," in B. Staw and L. Cummings (Eds.), *Research in Organizational Behavior*, Vol. 7, JAI Press, Greenwich, Conn., 1985.
TVERSKY, A. AND D. KAHNEMAN, "Judgment under Uncertainty: Heuristics and Biases," *Science*, 185 (1974), 1124–1131.
UTTERBACK, J., "The Process of Technological Innovation within the Firm," *Acad. Management J.*, 14 (1971), 75–88.
VAN DE VEN, A., "Problem Solving, Planning, and Innovation. Part 1. Test of the Program Planning Model," *Human Relations*, 33 (1980a), 711–740.
———, "Problem Solving, Planning, and Innovation. Part 2. Speculations for Theory and Practice," *Human Relations*, 33 (1980b), 757–779.
———, "Strategic Management Concerns among CEOs: A Preliminary Research Agenda," Presented at Strategic Management Colloquium, University of Minnesota, Minneapolis, October 1982.
——— AND ASSOCIATES, "The Minnesota Innovation Research Program," Strategic Management Research Center, Minneapolis, Discussion Paper #10, 1984.
——— AND R. HUDSON, "Managing Attention to Strategic Choices," in J. Pennings (Ed.), *Strategic Decision Making in Complex Organizations*, Jossey-Bass, San Francisco, 1984.
VON HIPPEL, E., "Successful Industrial Products from Customer Ideas," *J. Marketing*, (January 1978), 39–40.
WEICK, KARL, *The Social-Psychology of Organizing*, Addison-Wesley, Reading, Mass., 1979.
WILSON, J., "Innovation in Organizations: Notes toward a Theory," in J. Thompson (Ed.), *Approaches to Organizational Design*, University of Pittsburgh Press, Pittsburgh, 1966.
ZALTMAN, G., R. DUNCAN AND J. HOLBEK, *Innovations and Organizations*, Wiley, New York, 1973.