ORGANIZATION SCIENCE
Vol. 2, No. 1, February 1991
Printed in U.S.A.

ORGANIZATIONAL LEARNING: THE CONTRIBUTING PROCESSES AND THE LITERATURES*

GEORGE P. HUBER

Graduate School of Business, University of Texas, Austin, Texas 78712

This paper differs from previous examinations of organizational learning in that it is broader in scope and more evaluative of the literatures. Four constructs related to organizational learning (knowledge acquisition, information distribution, information interpretation, and organizational memory) are articulated, and the literatures related to each are described and critiqued.

The literature on *knowledge acquisition* is voluminous and multi-faceted, and so the knowledge acquisition construct is portrayed here as consisting of five subconstructs or subprocesses: (1) drawing on knowledge available at the organization's birth, (2) learning from experience, (3) learning by observing other organizations, (4) grafting on to itself components that possess knowledge needed but not possessed by the organization, and (5) noticing or searching for information about the organization's environment and performance. Examination of the related literatures indicates that much has been learned about learning from experience, but also that there is a lack of cumulative work and a lack of integration of work from different research groups. Similarly, much has been learned about organizational search, but there is a lack of conceptual work, and there is a lack of both cumulative work and syntheses with which to create a more mature literature. Congenital learning, vicarious learning, and grafting are information acquisition subprocesses about which relatively little has been learned.

The literature concerning *information distribution* is rich and mature, but an aspect of information distribution that is central to an organization's benefitting from its learning, namely how units that possess information and units that need this information can find each other quickly and with a high likelihood, is unexplored. *Information interpretation*, as an organizational process, rather than an individual process, requires empirical work for further advancement. *Organizational memory* is much in need of systematic investigation, particularly by those whose special concerns are improving organizational learning and decision making. (ORGANIZATIONAL ADAPTATION; ORGANIZATIONAL CHANGE; ORGANIZATIONAL INFORMATION PROCESSING; ORGANIZATIONAL LEARNING)

The purpose of this paper is to contribute to a more complete understanding of organizational learning. The paper elaborates four constructs integrally linked to organizational learning (knowledge acquisition, information distribution, information interpretation, and organizational memory) and describes needs and opportunities for further research and for integration of work already completed. It differs from previous examinations of organizational learning (Hedberg 1981; Shrivastava 1983; Fiol and Lyles 1985; Levitt and March 1988) in that it is broader in the scope of its subject matter and it evaluates the literatures more critically. In particular, the paper notes and attempts to explain the general lack of cumulative work and the lack of synthesis of work from different research groups. It also notes that thus far only a very small proportion of the work is presented in forms and forums that give it social or administrative value.

Intentional learning is the focal process in the lives of scientists and educators. Small wonder that when organizational scientists think about organizational learning, they often think of it as an intentional process directed at improving effectiveness. The prominence of this instrumental perspective in the managerial literature (Porter

*Accepted by Lee S. Sproull and Michael D. Cohen; received September 11, 1990.

1047-7039/91/0201/0088/$01.25

1980; Sammon, Kurland, and Spitalnic 1980) undoubtedly contributes additionally to its pervasiveness in the organizational science literature. Some authors (Argyris and Schon 1978, p. 323; Fiol and Lyles 1985, p. 803) have gone so far as to imply that organizational effectiveness must be enhanced in order to claim that organizational learning has occurred.

It is important to challenge narrow concepts of organizational learning, or of any phenomenon early in the history of inquiry, as narrow conceptions decrease the chances of encountering useful findings or ideas. Consequently, it seems important to highlight that learning need not be conscious or intentional, as is apparent in discussions of operant conditioning in humans and other animals (Bower and Hilgard 1981) and in case studies of organizational learning (March and Olsen 1979).

Further, learning does not always increase the learner's effectiveness, or even potential effectiveness. Learning does not always lead to veridical knowledge. Sample data are not always representative and new findings sometimes overturn what was previously "known to be true." Entities can incorrectly learn, and they can correctly learn that which is incorrect.

Finally, learning need not result in observable changes in behavior.

> Change resulting from learning need not be visibly behavioral. Learning may result in new and significant insights and awareness that dictate no behavioral change. In this sense the crucial element in learning is that the organism be consciously aware of differences and alternatives and have consciously chosen one of these alternatives. The choice may be not to reconstruct behavior but, rather, to change one's cognitive maps or understandings (Friedlander 1983, p. 194).

In view of the above, here a more behavioral perspective is taken: *An entity learns if, through its processing of information, the range of its potential behaviors is changed.* This definition holds whether the entity is a human or other animal, a group, an organization, an industry, or a society. The information processing can involve acquiring, distributing or interpreting information.[1] When the entity is an organization, these processes are frequently interpersonal or social, but they are occasionally more mechanical, and they can often be usefully viewed as logistical processes.

More meaning is given to organizational learning by characterizing it in terms of attributes. Four seem especially germane—existence, breadth, elaborateness, and thoroughness. With respect to the *existence* of organizational learning, let us assume that *an organization learns if any of its units acquires knowledge that it recognizes as potentially useful to the organization.*[2] A corollary assumption is that an organization learns something even if not every one of its components learns that something. These two assumptions are not universally held, but are widely held. For fuller discussions of the assumptions see Beer (1972), Douglas (1986), Morgan (1986), Sandelands and Stablein (1987), and Sims, Gioia, and Associates (1986).

[1]The words information and knowledge will be used interchangeably in this paper. I have, however, tried to use *information* when referring to data that give meaning by reducing ambiguity, equivocality, or uncertainty, or when referring to data which indicate that conditions are not as presupposed, and have tried to use *knowledge* when referring to more complex products of learning, such as interpretations of information, beliefs about cause-effect relationships, or, more generally, "know-how." While I believe that most readers will be comfortable with this usage, I note that cognitive psychologists (cf. Paris, Lipson and Wixson, 1983) have developed their own terminology and divide knowledge into "declarative"(i.e., facts), "procedural" (e.g., know-how, scripts), and "conditional" (as in "under what circumstances does this apply").

[2]Living systems sense and otherwise process enormous amounts of data. For some purposes even a fleeting, unintended storage in the entity's short-term memory should be viewed as learning. Given the length and purposes of this paper, however, employing the phrase "that it recognizes as potentially useful" is helpful in that it avoids having to deal with the murky construct of "latent information", data acquired but unrecognized by any organizational unit as having any potential use.

It will be argued in §2 that *more organizational learning occurs when more of the organization's components obtain this knowledge and recognize it as potentially useful.* This assertion addresses the *breadth* of organizational learning. It will be contended in §3 that, with regard to an item of information, *more organizational learning occurs when more and more varied interpretations are developed*, because such development changes the range of potential behaviors. This assertion is concerned with the *elaborateness* of organizational learning. Finally, again in §3, it will be argued that *more organizational learning occurs when more organizational units develop uniform comprehensions of the various interpretations.* What is uniform here is not necessarily the perceived value or validity of the interpretation, as would be the case in "groupthink" (Janis 1972). Rather, what is uniform are the understandings across units of the possibly different interpretations. *Thoroughness* of organizational learning is the attribute addressed with this assertion.

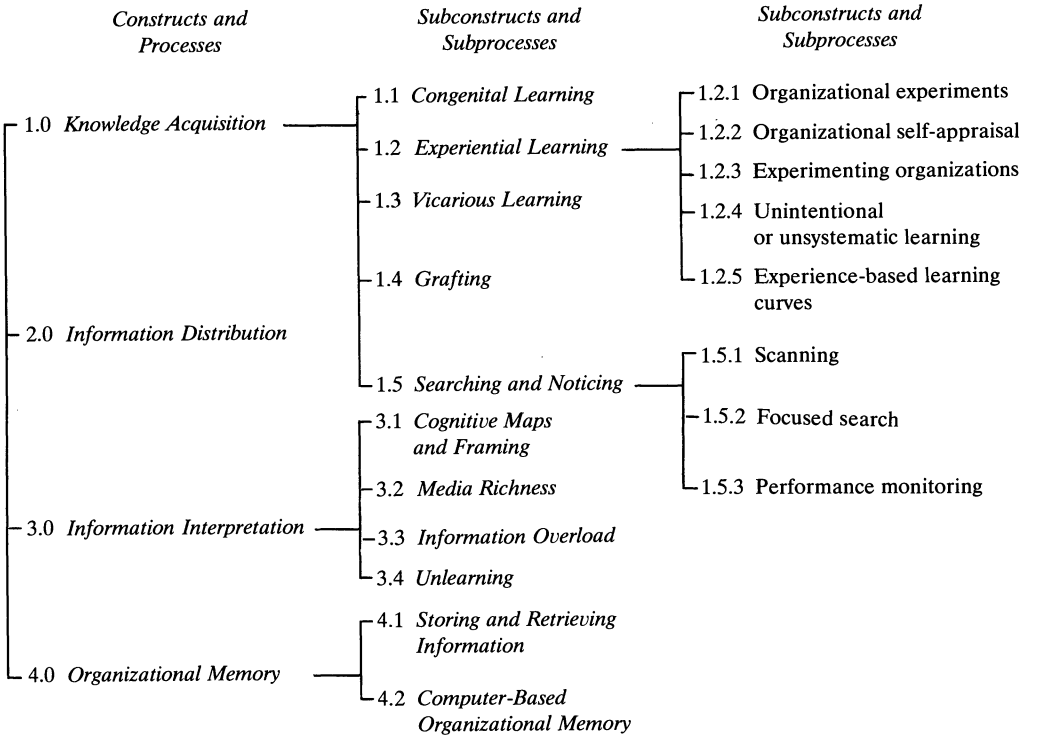

FIGURE 1. Constructs and Processes Associated with Organizational Learning.

The paper deals with four learning-related constructs (see Figure 1). Each is treated in a subsequent section of the paper. *Knowledge acquisition* is the process by which knowledge is obtained. *Information distribution* is the process by which information from different sources is shared and thereby leads to new information or understanding. *Information interpretation* is the process by which distributed information is given one or more commonly understood interpretations. *Organizational memory* is the means by which knowledge is stored for future use. The last section of the paper contains some suggestions for researchers interested in learning more about organizational learning.

1. Knowledge Acquisition

Many formal organizational activities are intended to acquire information or knowledge. Examples are customer surveys, research and development activities, performance reviews, and analyses of competitor's products. Many informal behaviors also are directed toward obtaining information or knowledge, for example, reading the *Wall Street Journal* or listening to coffee break "news". The following discussion is organized around five processes through which organizations acquire information or knowledge: (1) congenital learning, (2) experiential learning, (3) vicarious learning, (4) grafting, and (5) searching (see Figure 1).

1.1. *Congenital Learning*

Organizations do not begin their lives with clean slates. The individuals or organizations that create new organizations have knowledge about the new organization's initial environment and about the processes the organization can use to carry out its creator's intentions, and they make this knowledge available to the new organization's members. More generally, "organizations are driven to incorporate the practices and procedures defined by prevailing rationalized concepts of organizational work and institutionalized in society" (Meyer and Rowan 1977, p. 340). From a new organization's perspective, both the institutionalized knowledge referred to by Meyer and Rowan (1977) and the more context specific knowledge imparted by the organization's creators are *inherited knowledge*.

There invariably exists a time interval between when an organization is first conceived of and the rather arbitrarily defined birth event (when, for example, an organization is "incorporated" or is formally granted a mission and resources by its parent organization). During this interval the organization's founders employ vicarious learning, grafting, or searching to learn on behalf of the organization-to-be. Thus an organization's *congenital knowledge* is a combination of the knowledge inherited at its conception and the additional knowledge acquired prior to its birth.

The nature of an organization is greatly influenced by the nature of its founders and its founding (Stinchcombe 1965; Kimberly 1979; Schein 1984; Boeker 1988, 1989). What an organization knows at its birth will determine what it searches for, what it experiences, and how it interprets what it encounters. While there seems to be universal agreement that congenital knowledge strongly influences future learning, many of the rich details of the matter are yet to be investigated.

1.2. *Experimental Learning*

After their birth, organizations acquire some of their knowledge through direct experience. Sometimes this learning is a result of intentional, systematic efforts. Much more frequently it is acquired unintentionally or unsystematically. The literature related to experimental learning is quite varied, and is discussed here under the following subheadings: (1) organizational experiments, (2) organizational self-appraisal, (3) experimenting organizations, (4) unintentional or unsystematic learning, and (5) experience-based learning curves. This subsection closes with an evaluation of the literature on learning from experience.

1.2.1. *Organizational experiments.* Experiential learning is enhanced by the availability and analysis of feedback. One approach to facilitating intentional organizational learning is to increase the accuracy of feedback about cause-effect relationships between organizational actions and outcomes. Another is to ensure the collection and analysis of such feedback. Both approaches are included in formal organizational experiments (cf. Wildavsky 1972; Lawler 1977; Staw 1977; Warner 1984), or in formal post hoc analyses of "natural" experiments (cf., Landau 1973; Huber, Ullman, and

Leifer 1979; Sitkin, forthcoming). Except for the relatively well understood processes involved in research and development and test marketing (Jelinek 1979; Tushman and Moore 1988), formal organizational experiments are not widely authorized by organizational administrators. One reason is that the need to project an image of decisiveness sometimes causes administrators and other leaders not to admit to the uncertainty that would motivate an experiment. In the case of either formal experiments or post hoc analyses of natural experiments, proprietary and political concerns tend to inhibit dissemination of any but positive findings (R. K. Carter 1971; Weiss 1973).

In spite of the importance of organizational experiments as learning mechanisms (e.g., experiments that test the market acceptability of new products or the effectiveness of new human services delivery programs), the literature contains very few studies of experimentation by organizations. What antecedent conditions favor or lead to organizational experiments? High trust? High needs for performance? A culture where tolerance for mistakes is central? (See Peters 1987, for radical ideas on how to create such a culture.) An exception to the general lack of empirical study of organizational experiments (evidenced in the review by Warner 1981) is the literature on program evaluation (Weiss 1973; Rossi and Freeman 1989), where in effect a program is an experiment even though that is not its purpose. Of course from this literature we do not find much insight into why or how organizational experiments are initiated.

The literature on organizational decision making describes two decision making processes where successful use requires intentional learning from feedback. One, Lindblom's (1959) method of "successive limited comparisons" involves proposing (e.g., in the form of legislation) movement to some condition or position other than the present undesirable condition or position, and obtaining feedback from those affected by the proposed movement. If the proposal passes this "trial balloon" political adversity test, the proposal is authorized and implemented. If the observed outcome of the implementation is favorable, but the new situation is still not satisfactory, the process is repeated, with the proposed movement in the same general direction as the previous movement. When the outcome of a movement is negative, movement in a new direction is proposed. At each step of this process, learning occurs and affects action. The second process, related to Lindblom's (1959) method, is Quinn's (1980) somewhat more focused process of "logical incrementalism" in which the organization's

> executives artfully blend formal analysis, behavioral techniques, and power politics to bring [about] cohesive step-by-step movements toward ends which initially are broadly conceived, but which are then constantly refined and reshaped as new information appears (Hax and Majluf 1988, p. 104).

1.2.2. *Organizational self-appraisal* is another form of experiential learning. Under this term I group a number of overlapping approaches that tend to focus on member interaction and participation as critical to learning, and on improving the organizational members' mental health and relationships as important goals of learning. These foci contrast with a focus on monitoring more objective measures of performance, such as assessing adherence to prior plans, a subject discussed in §1.5.3. *Action research*, a relatively data intensive approach to organizational self-appraisal, includes gathering information about problems, concerns, and needed changes from organizational members, organizing this information, sharing it with the members, and involving the members in choosing, planning, and implementing actions to correct problems identified (Lewin 1946; McNamara and Weeks 1982; Argyris 1983; Trist 1983; Peters and Robinson 1984). Action research is one of several approaches employed in the field of *organizational development*, a field devoted to inducing

change in organizations (Burke 1982; Beer and Walton 1987; French and Bell 1990) in order to improve the quality of working life of the organization's members (Faucheux, Amado, and Laurent 1982).

Some organizational self-appraisal literature stresses cognitive aspects of learning and focuses on learning new frames of reference (Dery 1983; Shrivastava and Schneider 1984). Argyris and Schon (1974, 1978) and Argyris (1982) articulate this concept in the form of a dichotomy, "single-loop" versus "double-loop" learning, where the latter is related to an organization's frame of reference:

> One type (of organizational learning) involves the production of matches, or the detection and correction of mismatches, without change in the underlying governing policies or values. This is called *single-loop learning*. A second type, *double-loop learning*, does require re-examination and change of the governing values. Single-loop learning is usually related to the routine, immediate task. Double-loop learning is related to the nonroutine, the long-range outcome (Argyris 1983, p. 116).

This conceptual distinction between learning within a frame of reference and learning a new frame of reference seems critically important, but empirical study of fundamental changes in organizational frames of reference (e.g., changes in organizational culture) has been limited primarily to case studies (cf. Argyris 1983; Tunstall 1983). It may be that more systematic empirical studies will not find the two types of learning to be distinct in practice. It will be interesting to see if organizational scientists can verify the case study findings by drawing on data bases involving many major organizational changes [such as Miller and Friesen's studies of "Momentum and Revolution in Organizational Adaption" (1980a) and "Archetypes of Organizational Transition" (1980b)].

1.2.3. *Experimenting organizations.* "Adaption to a particular niche... while it leads to short-run survival, is never adequate for survival in the long run... Adaptability is the capacity to expand niches or to find new niches" (Boulding 1978, p. 111). Organizational experiments and self-appraisals are generally directed toward enhancing *adaptation*, while maintaining organizational experiments is generally directed toward enhancing *adaptability*.

How can organizations obtain and maintain adaptability? One group of researchers has suggested that organizations should operate themselves as "experimenting" or "self-designing" organizations, i.e., should maintain themselves in a state of frequent, nearly-continuous change in structures, processes, domains, goals, etc., even in the face of apparently optimal adaption (Nystrom, Hedberg, and Starbuck 1976; Hedberg, Nystrom, and Starbuck 1976; Starbuck 1983). Hedberg, Nystrom, and Starbuck (1977) argue that operating in this mode is efficacious, perhaps even required, for survival in fast changing and unpredictable environments. They reason that probable and desirable consequences of an ongoing state of experimentation are that organizations learn about a variety of design features and remain flexible. Experimenting organizations would thus be less resistant to adopting unfamiliar features or engaging unfamiliar environments, i.e., they would be adaptable. It is interesting to contrast this reasoning with the observation of Levitt and March (1988):

> Since frequent changes accentuate the sample size problem by modifying a situation before it can be comprehended, such behavior is likely to lead to random drift rather than improvement (Lounamaa and March 1987). Reducing the frequency or magnitude of change, therefore, is often an aid to comprehension, though the benefits of added information about one situation are purchased at a cost of reduction in information about others (Levinthal and Yao 1988). (Levitt and March 1988, p. 334).

The proposal that organizations should operate themselves as experimenting organizations has had almost no effect on either practice or research. But the utility of many novel ideas is not immediately recognized—there may be instances or conditions in which experimenting organizations do or might thrive and survive [cf., Mintzberg and McHugh's (1985) description of the National Film Board of Canada, especially p. 189, and also Nonaka's (1988) discussion of certain learning-enhancing practices in Japanese firms]. Do experimenting organizations or close approximations exist? What are the enabling conditions? Why has the idea of experimenting organizations received so little attention in the literature, except for attention from its originators? These questions beg to be answered by those seeking a full understanding of the domain of organizational learning.

1.2.4. *Unintentional or unsystematic learning* has been studied experimentally, analytically, and through interpretation of archival data. Experimental studies of learning by groups appeared during the late 1950's and early 1960's (Chapman, Kennedy, Newell, and Biel 1959; Dill and Doppelt 1963; Cangelosi and Dill 1965). Judged by today's standards, these studies were not methodologically sophisticated, and they were minimally cumulative in that they tended not to draw upon or extend the results of previous studies. They did, however, often lead to observations that have not been contradicted, e.g., that group or organizational learning is often haphazard and multi-faceted. Experimental work on organizational learning has nearly ceased (but see Miles and Randolph 1980, for an exception). Why this has occurred is unclear. Its demise seems unfortunate.

Analytic work was more common during the 1980's. Levinthal and March (1981) studied the nature and consequences of adaptive search in the context of a firm searching for new technologies. Cohen (1981) examined the effects of organizational structure on the effectiveness of search. Harrison and March (1984) demonstrated that post-decisional feedback about decision outcomes is necessarily more likely than not to be disappointing, and that the degree of disappointment is a function of the number of alternatives considered and the accuracy of the estimates of the payoffs associated with choosing the alternatives. Herriott, Levinthal, and March (1985) examined the effects of several variables on experiential learning in the context of budgeting resources across return-producing activities. Lounamaa and March (1987) studied learning by modelling a two-person team whose members learn about each other in the process of coordinating their actions. These works provide interesting findings, but are decidedly noncumulative. The interesting finding that fast learning is sometimes disadvantageous (Levinthal and March 1981; Herriott, Levinthal, and March 1985; Lounamaa and March 1987) seems plausible as developed and discussed by Levitt and March (1988), but the frequency and nature of this phenomenon deserve investigation in field settings.

March and Olsen (1979) describe instances of unintentional or unsystematic organization learning in real organizations. Other than these retrospective interpretations, there appear to be few if any published observational or archival studies where unintentional or unsystematic organizational learning was the focal topic of interest. Systematic field studies of unintentional organizational learning would considerably enhance our understanding of the phenomenon and could serve as bases for critiquing and guiding laboratory and analytic work.

1.2.5. *Experience-based learning curves.* What is the hard evidence that an organization's experience enhances its performance? Using years in the industry as a proxy for experience, and even after controlling for size and the development of resource-enhancing linkages, Brittain (1989) found experience to predict organizational survival. An extensive literature (Dutton, Thomas, and Butler 1984; Mody 1989; Muth 1986; Yelle 1979) documents the positive effect of experience on performance—as

manufacturing organizations gain experience in producing a new product, their production cost and production time per unit decrease. The magnitudes of the reductions are often predictable from a mathematical model (sometimes called an "experience curve" or a "learning curve"), and the predictions are frequently used in planning. Recent work (Epple, Argote, and Devadas, this issue) demonstrates how nonsimple learning-curve models can be used to investigate possible explanations of organizational learning. This is an important use of such models, as empirical studies (cf. Joskow and Rose 1985, and Zimmerman 1982) make clear that a number of contingency variables may be required for an accurate explanation to be achieved.

1.2.6. *Evaluation of the literature on learning from experience.* A desirable feature of the literature on learning from experience is that the studies employ multiple methods (e.g., laboratory experiments, mathematical analysis, computer simulations, and retrospective analysis of organizational events). Another desirable characteristic is that the literature is replete with fresh insights. Some observations about the difficulties encountered in organizational learning from experience, especially when the learning is unintentional or unsystematic, are shown in Table 1.

TABLE 1
A Sample of Obstacles to Organizational Learning from Experience

The organization's members, as sensors of experience, function imperfectly (Feldman 1986). Some of these shortcomings are pervasive (Harrison and March 1984; Schwenk 1984; Hogarth 1987) and others depend on the member's position, background, and style (Dearborn and Simon 1958; Ireland et al. 1987; Nutt 1986).
Feedback of the results of organizational action is often distorted or suppressed (Huber 1982; Weiss 1980) or arrives after the need for learning as a basis for changing the action has passed (Starbuck and Milliken 1988).
Units capable of learning from the experience of other units may not have access to this experience, as a consequence of either routine rules for message routing (Huber 1982) or organizational politics (Newman 1985).
Apparent "consequences of organizational actions" may be unrelated to organizational actions; "superstitious learning" occurs (Levitt and March 1988; Ouchi 1984, pp. 3–4).
As a result of its having developed a high level of competence in one process when comparing this process to other processes, an organization may come to perceive this process as superior to other processes in which it has less competence. The latter processes may actually be superior, and would have been found to be so if the organization had developed competencies in them equal to its competence in the process that was observed to be more effective (Levitt and March 1988).

Examining the literature on experiential learning makes clear that a great deal has been learned, but also raises four concerns. The first relates to the nature of the literature. Holding aside the literature on experience-based learning curves, the literature on organizational learning from experience contains very few formal, systematic field studies. The second concern is that the number of independent investigators examining any particular issue is small. The third concern has to do with the relative absence of studies that build on the results of previous studies. For example, in contrast to the studies concerning the effects of experience in manufacturing, the analytic studies of unintentional or unsystematic organizational learning tend only to reference, rather than draw upon, the previous results of analytic studies.[3] The fourth concern is the lack of intellectual interaction among investigators

[3]It may be that the difference between the extent of cumulation in these two example clusters is a consequence of the size or density of the clusters. In dense clusters of studies, such as the experience-curve

from different groups. Work reported by any one group rarely builds on findings or ideas from other groups. If the issues investigated were so unique that attention to the work of outsiders would be dysfunctionally distracting, then this parochial behavior would be understandable, but the issues are not conceptually that different.

We have examined processes where the experience leading to learning was first-hand. The next two processes to be examined involve organizations acquiring knowledge through second-hand experience.

1.3. *Vicarious Learning*: *Acquiring Second-Hand Experience*

Organizations commonly attempt to learn about the strategies, administrative practices, and especially technologies (Czepiel 1975; Sahal 1982) of other organizations. For example,

> borrowing from other organizations is one form of organizational learning. Manufacturers such as automobile and computer companies have for years routinely examined in detail their competitors' products as they appear in the marketplace (Eells and Nehemiks 1984).

"Corporate intelligence" is the term associated with the idea of searching for information about what corporate competitors are doing and how they do it (Fuld 1988; Gilad and Gilad 1988; Porter 1980; Sammon, Kurland and Spitalnic 1984). Channels for acquiring this information include consultants, professional meetings, trade shows, publications, vendors and suppliers and, in less competitive environments, networks of professionals.

"Institutional theory" (Meyer and Rowan 1977; Zucker 1987) holds that organizations pervasively imitate other organizations because doing so minimizes sanctions from a variety of stakeholders. House and Singh (1987), drawing considerably on March (1981), state that mimicry occurs particularly" when technologies are poorly understood and when goals are ambiguous" (1987, p. 709). In contrast, it appears that mimicry is not efficacious when environments are both competitive and fast-changing. Based on their empirical study of organizations in just such an environment, Bourgeois and Eisenhardt (1988) concluded that "Imitation is often not viable . . . as it implies both waiting and jumping into an occupied niche" (1988, p. 833). A rich discussion of the circumstances where acquiring second-hand experience through imitation is, and is not, to be preferred over learning through first-hand experience is provided by Dutton and Freedman (1985).

The literature on diffusion of technologies and administrative practices has been suggested by Dutton and Freedman (1985) and Levitt and March (1988) as a source of information for researchers interested in organizational learning through imitation. However, Mahajan, Sharma, and Bettis (1988) provide reasoning and data that do not support the diffusion model, and suggest that imitation may be a more limited form of organizational learning than has been suggested previously. Accurate models of learning through imitation may require some degree of complexity. For example, in their study of cross-organizational learning in shipyards, Argote, Beckman, and Epple (1990) found that imitation played a much larger role at the time that shipyards initiated production than after production was ongoing. Whether organizations imitate high status organizations (e.g., Toyota, IBM) as a result of the same forces that

---

cluster, there may not be niches for additional free-standing studies—much of what an investigator might do may have been done, and so the investigator adds (marginally) to previous work. In contrast, in sparse clusters, such as the analytic studies of organizational learning, the benefits from relatively divergent, unconnected studies may outweigh the benefits from superimposed, cumulative studies.

cause people to imitate the actions of celebrities or other high status individuals is a matter in need of theoretical and empirical investigation.

1.4. *Grafting*

Organizations frequently increase their store of knowledge by acquiring and grafting on new members who possess knowledge not previously available within the organization. Sometimes grafting-on of carriers of new knowledge is done on a large-scale basis, as in the case of an acquisition of a whole organization by another. A well-known example is General Motors' acquisition of Ross Perot's corporation, EDS, in order to obtain the information systems expertise possessed by EDS. For acquiring complex forms of information or knowledge, grafting is often faster than acquisition through experience and more complete than acquisition through imitation.

Empirical studies of knowledge acquisition through grafting are scarce, but see Lyle's (1988) examination of knowledge acquisition through joint ventures. The work of Jemison and Sitkin (1986a, b) on the necessity of attending to the process dimension of mergers is relevant and perhaps indicative of the type of work that will be useful in the future. We can expect that, as the rate at which organizations must assimilate new knowledge continues to increase (Huber 1984; Drucker 1988), grafting will become a more frequently used approach for organizations to acquire quickly knowledge that is new to them.

The last of the five information acquisition processes to be discussed is learning by searching or noticing. The literature seems to indicate that searching is the process most consciously pursued by managers on a day-to-day basis.

1.5. *Searching and Noticing*

Organizational information acquisition through search can be viewed as occurring in three forms: (1) scanning, (2) focused search, and (3) performance monitoring. *Scanning* refers to the relatively wide-ranging sensing of the organization's external environment. *Focused search* occurs when organizational members or units actively search in a narrow segment of the organization's internal or external environment, often in response to actual or suspected problems or opportunities. *Performance monitoring* is used to mean both focused and wide-ranging sensing of the organization's effectiveness in fulfilling its own pre-established goals or the requirements of stakeholders. *Noticing* is the unintended acquisition of information about the organization's external environment, internal conditions, or performance. Space constraints preclude further discussion of noticing, but see Starbuck and Milliken (1988).

1.5.1. *Scanning.* Organizational environments change. If the lack of fit between an organization and its environment becomes too great, the organization either fails to survive or undergoes a costly transformation (Miller and Friesen 1980a, b; Tushman and Romanelli 1985). In recognition of this, organizations scan their environments for information about changes (Wilensky 1967; Fahey, King, and Narayan 1981). Scanning varies in intensity from high vigilance, active scanning, to the routine scanning or mere maintenance of a state of alertness for nonroutine (but relevant) information, as in the "passive search" noted by Mintzberg, Raisinghani, and Theoret (1976, p. 255).

Two literatures relate to scanning, one in which the organization or department is the unit of analysis (the "macro" literature) and one in which the individual is the unit of analysis (the "micro" literature). The macro literature (cf. Aguilar 1967; Hambrick 1982; Jemison 1984; Dutton and Freedman 1985) is dominated by research related to environmental scanning for enhancing strategic management effectiveness. Fundamental to this literature is the assumption that scanning contributes to perfor-

mance, an assumption that has been validated in a variety of studies (Tushman and Katz 1980; Dollinger 1984; Daft, Sormunen, and Parks 1988).

The micro literature on scanning focuses on boundary-spanning personnel as sensors of the organization's environment. Two streams of research are apparent. One, on gatekeepers in the research and development industry, is relatively mature—empirical studies build on earlier conceptualizations and empirical studies (Tushman 1977; Gerstenfeld and Berger 1980). A modest theory linking gatekeeper characteristics and behavior to organizational performance has been developed by Tushman and his associates (Tushman 1979; Tushman and Katz 1980; Tushman and Scanlan 1981). A second and still developing stream of research deals with the environmental monitoring behavior of upper-level managers. It is less mature, consisting largely of field studies of managerial activities (Keegan 1974; Mintzberg 1975; Kurke and Aldrich 1983; Dollinger 1984). Theory-testing studies of boundary spanners as sensors of the environment are not common (but see Blandin and Brown 1977, Hambrick 1982, Leifer and Huber 1977, and Schwab, Ungson and Brown 1985).

1.5.2. *Focused search.* The organizational science literature related to focused search has dealt primarily with two matters: the antecedents to focused search and the nature of focused search. With respect to antecedents, early authorities noted that the initiation of focused search is not a casual behavioral change. For example, Reitzel (1958) emphasizes that there seems to be a general reluctance to initiate focused search unless it is clearly necessary.

> Not until the element of novelty in a problem situation has become clearly explicit will a significant disruption of the relationship between the environment and the organism be sharply felt and a search begin for alternatives to the habitual response. Then and only then does a more or less conscious and deliberate decision-making process get initiated (1958, p. 4)

Downs (1966, p. 190) and Ansoff (1975) also suggested that for search-prompting signals to have an effect they must be very "loud" and received from multiple sources, and Feldman and Kanter stated that "the organization will search for additional alternatives when the consequences of the present alternatives do not satisfy its goals" (1965, p. 622). In addition, it is apparently not only that the need for focused search be clear, but also that effort directed toward resolving the problem (or capitalizing on the opportunity) be viewed as having a satisfactory probability of success (Glueck 1976, p. 70; Schwab, Ungson and Brown 1985).

Cyert and March (1963, pp. 44–82, 120–122) observe that search tends to be focused in the vicinity of the problem symptoms or the current alternative, i.e., on options that are readily available or that have been directed at similar problems in the past, and O'Reilly (1982) and Culnan (1983) find that the choice of information sources is greatly affected by source accessibility. Together these ideas suggest that some sort of threshold must be exceeded before search will take place, where the threshold is defined both in terms of the costs and benefits associated with searching versus not searching and in terms of the probabilities that these costs and benefits will be incurred. Mintzberg, Raisinghani, and Theoret's (1976) discussion of a search initiation threshold is in terms of these variables. Thus the thrust of much of the literature is that organizations will initiate focused search when (1) a problem is recognized and (2) some heuristic assessment of the costs, benefits, and probabilities involved suggests that a search-justifying threshold value has been reached or exceeded. Cyert and March (1963) argued that these two conditions are both necessary and sufficient for focused search to occur—such search will not be initiated unless such conditions occur and will be initiated if they occur. In contrast to this emphasis on recognition of a problem as the impetus for search, in his extension of Cyert and

March's (1963) *A Behavioral Theory of the Firm*, Carter (1971) observes internally initiated search in the form of search for opportunities in the environment:

> The procedure was for the president to initiate probes by mentioning, either in casual conversation or by explicit memorandum, that Comcor was interested in purchasing certain types of companies. Staff members could then seek companies that fit the requirements (1971, p. 420).

Whether focused search is largely reactive or proactive is related to the issue of determinism versus voluntarism in organizational change (Astley and Van de Ven 1983; Hambrick and Finkelstein 1987). My speculation is that in organizational subunits and at lower organizational levels search is largely reactive to problems, but that in autonomous organizations and at higher organizational levels a significant proportion of search is a consequence of proactive managerial initiatives. Underlying these possible relationships is the likelihood that organizational slack and managerial discretion (Allen 1979; Hambrick and Finkelstein 1987) are more frequent at higher organizational levels, and that slack and discretion are key determinants of whether search behavior will be proactively initiated.

1.5.3. *Performance monitoring.* One of the clearest and most pervasive forms of organizational search is performance monitoring. Organizations formally and routinely assess how well they are meeting both their own standards, such as inventory levels, and the expectations of external constituencies and stakeholders. In addition, as Mintzberg (1975) makes clear, managers informally monitor conditions in their organization. While performance monitoring has as its ultimate purpose improving performance, Crozier (1965) takes a very pessimistic view and argues that bureaucratic organizations simply "cannot correct their behavior by learning from their errors" (1965, p. 186). Wildavsky (1972), Landau (1973) and Staw and Ross (1987) present somewhat more broadly based analyses of when and how it is that organizations do not use feedback to improve their performance.

1.5.4. *Evaluation of the literature on learning by searching* indicates that much has been learned, but identifies two problems. One of these is the *lack of conceptual work*. For example, no distinction has been made between focused search for solutions and focused search for information about already identified solutions (the former being more a matter of discovery or identification and the latter being more one of investigation). The distinction might be useful, as the various forms of search might have different antecedents or might be carried out by different types of organizational units or with different types of search processes. Some support for this idea is Fredrickson's (1985) finding that preferred search processes varied according to whether the stimulus was a problem or an opportunity, and also Dutton and Jackson's (1987) thoughts about how the labeling of a situation as a threat or opportunity might affect organizational actions.

Another example of conceptual work that might be useful concerns the *information environment*, the set of symbols, data, and other indicators of the environment that is subject to being sensed by the organization and that stands conceptually between the actual environment and the perceived environment (Huber and Daft 1987). Once conceptualized, the information environment can be thought of as having characteristics, such as completeness, unbiasedness, and clarity, that may be important predictors of organizational learning and that seem subject to enhancement through managerial action.

The second problem identified when evaluating the organizational search literature is that, while early field studies (Cyert and March 1963) were used to build and to test

theory (Weber 1965; Gerwin 1969; E. E. Carter 1971), in recent years there has been a *lack of theory-testing field work*.

Before closing this section on search, it seems worthwhile to note that not all organizational search is carried out for the purpose of learning. For example, organizational decision makers must frequently legitimate their decisions to others. Sabatier (1978) discusses this point at some length and notes a number of field studies where information was sought for the explicit purpose of legitimating decisions reached on other grounds. Similarly, their extensive interview study of mid-to-high level public officials led Weiss and her associates to state that:

> If research (information) is used, it usually... is expected to convince other people of the credibility and legitimacy of one's position. Several people spoke about... the use of research (information) as ammunition in the political wars (Weiss 1980, p. 388).

The needs to reduce their post-decisional dissonance, to legitimate decisions to others, and to project an image of thoroughness and objectivity frequently cause organizations and their members to search for more information than is necessary to solve the focal problem. This may be a partial explanation for the oft-repeated observation that decision makers acquire "too much" information. [See Connolly (1988) for a review and critique of the literature that supports this point of view. Also see Feldman and March (1981) for a discussion of the conspicuous display of information search behavior as a mechanism for managing perceptions, and March and Sevon (1984) for a discussion of still other uses of information and information-related behaviors in and by organizations.]

To some extent the five information-acquisition processes just discussed can be substitutes for each other. On the other hand, some have characteristics that favor their use in certain situations. For example, vicarious learning and grafting seem like they would be faster than experiential learning for obtaining technical "know how." As another example, given the difficulties inherent in changing an individual's or an organization's frame of reference (see §1.2.2), it seems that under some circumstances experience would be a very poor teacher and that vicarious learning, grafting, or searching would therefore be necessary for learning to occur. Under other circumstances only experience would convince a recalcitrant learner/adapter that the externally observed frame of reference was locally valid.

Many organizational members and units that serve as knowledge acquirers also have, as part of their role, sharing what they have acquired with other organizational components. This brings us to the subject of information distribution.

2. Information Distribution

Information distribution is a determinant of both the occurrence and breadth of organizational learning. With regard to occurrence of organizational learning, consider that organizational components commonly develop "new" information by piecing together items of information that they obtain from other organizational units, as when a shipping department learns that a shortage problem exists by comparing information from the warehouse with information from the sales department.

With respect to the idea that information distribution leads to more broadly based organizational learning, consider the fact that organizations often do not know what they know. Except for their systems that routinely index and store "hard" information, organizations tend to have only weak systems for finding where a certain item of information is known to the organization. But when information is widely distributed in an organization, so that more and more varied sources for it exist, retrieval efforts are more likely to succeed and individuals and units are more likely to be able to

learn. Thus, information distribution leads to *more broadly based* organizational learning. This is in contrast to the previous idea that information distribution leads to *new* organizational learning.

Researchers in organizational behavior and organizational communications have learned a great deal about information distribution in organizations, and reviews are numerous (Guetzkow 1965; Thayer 1967; Farace and McDonald 1974; Porter and Roberts 1976; O'Reilly and Pondy 1980; Huber 1982; Krone, Jablin, and Putnam 1987). Drawing on these reviews allows us to summarize much of what is relevant for our immediate purpose in the form of a modest number of propositions (see Table 2).

TABLE 2
Propositions Concerning Information Distribution in Organizations *

A. The probability that organizational member or unit A will rout information to member or unit B is:
   1. positively related to A's view of the information's relevance to B,
   2. positively related to B's power and status,
   3. negatively related to A's view of A's costs of routing the information to B
   4. negatively related to A's workload,
   5. positively related to the rewards and negatively related to the penalties that A expects to result from the routing, and
   6. positively related to the frequency with which A has previously routed information to B in the recent past.

B. The probability or extent of delay in the routing of information by A to B is:
   1. positively related to the workload of A,
   2. positively related to the number of sequential links in the communication chain connecting A to B, and
   3. negatively related to A's view of the timeliness of the information for B

C. The probability or extent of information distortion by A when communicating to B is:
   1. positively related to A's view of the consequent increase in A's goal attainment that will result from the distortion,
   2. negatively related to the penalty that A expects to incur as a result of introducing the distortion,
   3. positively related to the amount of discretion allowed in the presentation format,
   4. positively related to the difference between the actual information and the desired or expected information,
   5. positively related to A's work overload, and
   6. positively related to the number of sequential links in the communication chain connecting A with B.

* From Huber (1982) and Huber and Daft (1987).

Organizational units with potentially synergistic information are often not aware of where such information could serve, and so do not route it to these destinations. Also, units which might be able to use information synergistically often do not know of its existence or whereabouts. How those who possess nonroutine information and those who need this information find each other is relatively unstudied, but deserves the attention of researchers interested in organizational learning. One organizational process that facilitates the coupling of those who need nonroutine information and those who have it is internal employee transfer, both employee-initiated and employer-initiated. The role of this process in intra-organizational information distribution is a prime candidate for empirical study.

Combining information from different subunits leads not only to new information but also to new understanding. This fact highlights the role of information distribution as a precursor to aspects of organizational learning that involve information interpretation:

> ...it is assumed that the organizational interpretation process is something more than what

als come and go, but organizations preserve knowledge, behaviors, mental maps, norms, and values over time. The distinctive feature of organization level information activity is sharing (Daft and Weick 1984, p. 285).

3. Information Interpretation

Daft and Weick (1984) define interpretation as "the process through which information is given meaning" (p. 294), and also as "the process of translating events and developing shared understandings and conceptual schemes" (p. 286). Do these definitions imply that, if all organizational units develop a common interpretation about an item of information, then more organization learning has occurred? Or has more organizational learning occurred if all units interpret the information differently? In other words, should organizational learning be defined in terms of the commonality of interpretation, or should it be defined in terms of the variety of interpretations held by the organization's various units? It seems reasonable to conclude that more learning has occurred when more and more varied interpretations have been developed, because such development changes the range of the organization's potential behaviors, and this is congruent with the definition of learning. It also seems reasonable to conclude that more learning has occurred when more of the organization's units understand the nature of the various interpretations held by other units. For example, more complete understanding can either enhance cooperation and thus increase the range of potential behaviors, or can inhibit cooperation and thus decrease the range of potential behaviors. In either case, more complete understanding leads to a change in the range of potential behaviors, i.e., to organizational learning.

There seems to have been little systematic study of the development of shared understanding among organizational units about particular events or items of information, but these has been some, and there are related literatures. For reviews of related literatures, see Isabella's (1990) review of the cognitive aspects of interpretation in organizations and her study of the temporal nature of interpretation, Jablin's (1984, 1987) reviews of socialization of new members, and Sproull's (1981) review of the role of face-to-face communication in constructing and maintaining interpretations of situations. Dutton, Fahey, and Narayanan (1983) provide a rich conceptual description of interpretation in the context of development of corporate strategy. How organizations develop interpretations of history from scattered and unique experiences is explained by March, Sproull, and Tamaz (this issue).

It seems likely that the extent of shared interpretation of new information is affected by (1) the uniformity of prior *cognitive maps* possessed by the organizational units, (2) the uniformity of the *framing* of the information as it is communicated, (3) the *richness of the media* used to convey the information, (4) the *information load* on the interpreting units, and (5) the amount of *unlearning* that might be necessary before a new interpretation could be generated. Other variables may also be determinants of shared interpretations (Bartunek 1984; Milliken 1990), but these five either follow from our earlier discussions or have been singled out in the literature as especially relevant. Each is discussed below.

3.1. *Cognitive Maps and Framing*

The facts that a person's prior cognitive map (or belief structure or mental representation or frame of reference) will shape his or her interpretation of information, and that these cognitive maps vary across organizational units having different responsibilities, are well established (Dearborn and Simon 1958; Ireland, Hitt, Bettis, and DePorras 1987; Kennedy 1983; Walker 1985; Zajonc and Wolfe 1966). Similarly, it is well established that how information is framed or labeled affects its interpreta-

tion (Dutton and Jackson 1987; Tversky and Kahneman 1985). If information is not uniformly framed when distributed to different units, uniform interpretations are less likely to be achieved. Of course, differences in language or cognitive maps across units may require that idiosyncratic messages be used to create uniform framings. An important feature of interpretations in organizations is that they are socially constructed (Sims and Gioia 1986). This fact introduces the role of communication media in the construction of common meaning.

3.2. *Media Richness*

Media richness is a determinant of the extent to which information is given common meaning by the sender and receiver of a message. It is defined as the communication "medium's capacity to change mental representations within a specific time interval" (Daft and Lengel 1984; Daft and Huber 1987, p. 14). It has two underlying dimensions—the variety of cues that the medium can convey and the rapidity of feedback that the medium can provide. Research supports the notion that managers who consider media richness when choosing a communication medium are more effective (Daft, Lengel, and Trevino 1987), and thus provides some support for the idea that media richness affects the development of common understanding.

Media can convey too great a range of symbols for some aspects of the interpretation task. For example, when assessing the effectiveness of various media, Short, Williams, and Christie (1976)

> found more opinion change via audio-only media. Kiesler et al. (1984) found significantly higher choice shift in computer-conferencing groups, although Hiltz and Turoff (1978) present contradictory evidence. Short et al. (1976) conclude that, whatever the benefits of face-to-face communication, it also distracts communicators from the task and from vocal cues that might indicate lying. By directing too much attention toward the communicators, face-to-face interactions may lead to ineffective task outcomes (Culnan and Markus 1987, pp. 428–429).

Before leaving this discussion of information interpretation, it is appropriate to note that shared interpretation of information is not necessary for organizational units to agree on action. For example, Donnellon, Gray, and Bougon (1986) interpret Weick (1979) as arguing that

> only minimal shared understanding is required, because organization is based primarily on exchange (e.g., of work for pay). That is, in order to produce organized action, group members need only share the knowledge that the exchange will continue. It is not necessary that members subscribe to the same goals or share the same interpretations of their joint action (1986, p. 43).

The empirical study by Donnellon et al. (1986) supports Weick's argument. Eisenberg (1984) and Eisenberg and Witten (1987) go further and argue that ambiguity facilitates agreement on actions in that it allows each unit to believe whatever is necessary to achieve consensus. See Weick and Bougon (1986) for further development of the idea of shared understanding. With regard to the relationships among clarity of communication, information interpretation, and organizational effectiveness, it seems important to move from speculation to empirical research.

3.3. *Information Overload*

Interpretation within or across organizational units is less effective if the information to be interpreted exceeds the units' capacity to process the information adequately (see the study by Meier 1963, and the reviews by Driver and Streufert 1969, and Miller 1978, Chapter 5). This fact was vividly portrayed by Schlesinger in his

testimony to the Senate Subcommittee on National Security and International Operations:

> What happened in Viet Nam is that we were simply drowned in statistics; we were drowned in information. A very small proportion of this information was adequately analyzed. We would have been much better off to have a much smaller take of information and to have done a better job of interpreting what that information meant (Schlesinger 1970, p. 482).

Clearly, overload detracts from effective interpretation. Further, as a result of variability in cognitive maps across units, even uniform overload, by creating ambiguity in the perceived input, will lead to nonuniform interpretation. This is because

> Presented with a complex stimulus, the subject perceives in it what it is ready to perceive; the more complex or ambiguous the stimulus, the more perception will be determined by what is already "in" the subject and the less by that is in the stimulus (Bruner 1957, pp. 132–133).

Overload that is not uniform across units leads, of course, to even greater disparities in the uniformity of interpretation and learning.

In his discussion of information overload, Simon (1973) concludes that organization designs that minimize the need for information distribution among the organization's units reduce the information load on the units, and should be adopted by organizations in excessively rich information environments. But this "design for informational autonomy" would reduce information sharing across units and would consequently curtail some types of organizational learning. For arguments supporting this latter point, in the research and development context, see Sitkin (forthcoming). Clearly the informational interconnectedness of units affects organizational learning in complex ways, and is one of the variables that should be investigated in future research.

3.4. *Unlearning and Its Effects on Learning*

"Unlearning" is an attention-catching term that appears in the organization and management literature (Hedberg 1981; Nystrom and Starbuck 1984; Klein 1989) and that begs to be addressed in a paper dealing with organizational learning. Hedberg (1981) is an early and frequently cited reference on unlearning. He defines unlearning as "a process through which learners discard knowledge" (Hedberg 1981, p. 18). By emphasizing unlearning as the discarding of "obsolete and misleading knowledge" (1981, p. 3), he implies that unlearning is functional, and perhaps intentional: "to forget" means not only "to lose the remembrance of" (Webster's 1987, p. 484), but also means "to disregard intentionally" (Webster's 1987, p. 484).

In attempting to define unlearning, it is important to note that an entity can unlearn behaviors, and it can unlearn constraints on behaviors. Thus unlearning can lead to either a decrease, or an increase, in the range of potential behaviors. It follows then, from the earlier definition of learning, that unlearning is conceptually subsumable under learning. Use of the word "unlearning" serves primarily to emphasize a decrease in the range of potential behaviors, rather than to indicate a qualitatively different process.

There are several effects of unlearning. One is that, because the organization is without a fact, belief, or script that it previously used, it becomes at least temporarily inactive in the context where this knowledge had been used. A second effect, if there is impetus for action, is that focused search is initiated to obtain a substitute fact, belief, or script that plays a parallel role in the organization's functioning. Whether search would be focused in the vicinity of that which was just unlearned, as might be suggested by either the thinking of Lindblom (1959) or Cyert and March (1963, p. 121), or would be focused far from this vicinity, as might be imagined if that which

is being unlearned is quite aversive, is a question that merits empirical study. A third possible effect of unlearning is that unlearning opens the way for new learning to take place; the reasoning is analogous to Kurt Lewin's idea that organizational change can best be implemented if a felt need for change is first created, if an "unfreezing" occurs (Lewin 1951). An extreme form of intentional unlearning by organizations is the discharge of employees, especially managers who are unable to move from outdated ways of doing things (Tunstall 1983).

An unusual effect of unlearning results from socialization of new organizational members. Socialization sometimes causes new members to unlearn. A consequence can be that the knowledge that the new members possessed upon entry becomes unavailable to the organization. Whether, when, and how socialization of those new members who have been brought in for the purpose of increasing the organization's knowledge (see §1.4 on grafting) should take place is a research opportunity with considerable significance for administrative practice.

4. Organizational Memory

Everyday experience and some research make clear that the human components of organizational memories are often less than satisfactory. Considering the many factors that contribute to inaccurate learning and incomplete recall (Kahneman, Slovic, and Tversky 1982; Nisbett and Ross 1980; Starbuck and Milliken 1988), this is not surprising. The problem of poor organizational memory is, however, much more complex than simple considerations of the deficiencies of humans as repositories of organizational information and knowledge might suggest. Everyday observations make clear (1) that personnel turnover creates great loss for the human components of an organization's memory; (2) that nonanticipation of future needs for certain information causes great amounts of information not to be stored (e.g., blackboards get erased, task completion times are not recorded) or not to be stored such that it can be easily retrieved (e.g., solutions to problems, even if stored, are often only crudely indexed), and (3) that organizational members with information needs frequently do not know of the existence or whereabouts of information possessed or stored by other members. It follows that variables likely to influence the ongoing effectiveness of organizational memory include (1) membership attrition, (2) information distribution and organizational interpretation of information, (3) the norms and methods for storing information, and (4) the methods for locating and retrieving stored information. We need not discuss membership attrition, as its deleterious effects on organizational memory are obvious, especially with respect to retention of tacit knowledge. In addition, we need not examine information distribution and interpretation, as the main idea—that the location of information and common interpretation in multiple memory nodes is associated with "more" learning—was discussed earlier.

4.1. *Storing and Retrieving Information*

Organizations store a great deal of "hard" information on a routine basis, sometimes for operating reasons and sometimes to satisfy the reporting requirements of other units or organizations. A great deal of organizational knowledge about how to do things is stored in the form of standard operating procedures, routines, and scripts (Feldman 1989; Gioia and Poole 1984; Nelson and Winter 1982, pp. 99–107), and, as Mintzberg's (1975) work indicates, managers and others routinely acquire and mentally store "soft" information as well.

What is not well understood, and would be an interesting subject for empirical research, is the extent to which nonroutine information is deliberately stored to be

used as a basis for future decision making. This behavior could involve anticipating future needs for the information. What variables determine such behavior? Several possibilities come to mind: the degree to which the future needs are predictable; the scope of future needs that the member can envision; the commitment to the well-being of the organization (or to other subunits if storage is not for oneself); and the accessibility and utility of the channels and mechanisms available for storage.

As a result of specialization, differentiation, and departmentalization, organizations frequently do not know what they know. The potential for reducing this problem by including computers as part of the organization's memory is considerable, and deserves investigation by organizational scientists as well as by computer scientists and information systems designers.

4.2. *Computer-Based Organizational Memory*

Information concerning the times necessary to complete fabrication of certain products, to receive shipments of ordered materials, to recruit or train various types of employees, or to deliver certain types of services are more and more frequently resident in computers as transactions artifacts, either those created and transmitted internally using the organization's electronic mail, electronic bulletin board, or electronic blackboard systems, or those exchanged electronically across the organization's boundaries (e.g., letters, billings, and contracts). Case-by-case foresight, smart indexing or, in the future, artificial intelligence (Johansen 1988, pp. 34–36) can facilitate retrieval of information from these artifacts. Automatic capturing and sophisticated retrieval of such information result in computer-resident organizational memories with certain properties, such as completeness and precision, that are superior to the human components of organizational memories. On-going increases in the "friendliness" and capability of computer-based information retrieval systems are lowering some obstacles to the implementation of the above ideas and practices.

What about "soft" information? Much of what an organization learns is stored in the minds of its members. In many cases organizations grow their own experts. These people are expert not in a whole discipline or broad category of problems, but rather have had organizational experiences that made them expert with respect to specific intellectual tasks such as (1) diagnosing quality problems or equipment malfunctions, (2) learning the identities of extra-organizational experts, influence peddlers, resource providers, or other nonmembers who may be useful to the organization, and (3) locating information or other resources not locatable using official, standard sources. Using the knowledge of these home-grown experts, organizations are creating computer-based expert systems (Rao and Lingaraj 1988; Rauch-Hindin 1988; Waterman 1986). Such expert systems have some properties, such as accessibility, reliability, and "own-ability," that are superior to those of human experts and that, in some situations, are useful components of organizational memories. Thus, even though expert systems have other properties that are inferior to those of human experts, as the friendliness and capability of expert systems increase, the proportion of an organization's "soft" and local information that is computer-resident increases. Research questions pertaining to the organizational issues involved in obtaining soft information and storing it in computers are noted in Huber (1990).

In closing this section, it seems appropriate to emphasize again the critical role of organizational memory in organizational learning. Two points seem worth noting. The first is that to demonstrate or use learning, that which has been learned must be stored in memory and then brought forth from memory; both the demonstrability and usability of learning depend on the effectiveness of the organization's memory. The second point is multifaceted: (1) *information acquisition* depends in many instances on attention, which is directed by previous learning retained in memory; (2) *informa-*

tion distribution is affected by organizational decisions made using criteria implied in Table 2, which are applied using information contained in memory; (3) *information interpretation* is greatly affected by cognitive maps or frames of reference, which are undefinable except in terms of a memory. Thus the basic processes that contribute to the occurrence, breadth, and depth of organizational learning depend on organizational memory. The construct of organizational memory is clearly important to the idea of organizational learning, but has received relatively little empirical study. For a historical study demonstrating the perceived importance of organizational memory to managers, see Yates (1990). For a critique of the organizational science literature on organizational memory, see Walsh and Ungson (1991).

5. Summary

In this paper, four constructs related to organizational learning (knowledge acquisition, information distribution, information interpretation, and organizational memory) were examined, and the literature related to each was described and critiqued. Because the literature on *knowledge acquisition* is voluminous and multi-faceted, the process was portrayed as consisting of five subconstructs or subprocesses: (1) congenital learning, (2) experiential learning, (3) vicarious learning, (4) grafting, and (5) searching or noticing. Examination of the related literatures indicated that, while much has been learned about experiential learning, there is a lack of cumulative work and a lack of synthesis of work from different research groups. Similarly, it was found that much has been learned about organizational search, but that there is a lack of conceptual work and a lack both of continuing empirical work and of integration with which to create a more mature literature. Congenital learning, vicarious learning, and grafting were found to be information acquisition subprocesses about which relatively little has been learned beyond the fact that they occur.

The literature concerning *information distribution* was found to be rich and mature. However, a key aspect of information distribution, namely how organizational units possessing information and units needing this information can find each other quickly and with a high likelihood, was found to be unexplored. *Information interpretation*, as an organizational process rather than as an individual process, was found to require empirical work for further advancement. Finally, *organizational memory*, as a determinant of organizational learning and decision making, was found to be much in need of systematic investigation.

A number of conclusions follow from this examination of organizational learning. One is that the organizational processes and subprocesses that contribute to changes in the range of an organization's potential behaviors are more numerous and varied than a small sampling of the organizational science literature might suggest. While any one research group can ignore this fact with little peril to itself, the field as a whole cannot. A second conclusion is that, with few exceptions (e.g., experience-based learning curves and information distribution), there is little in the way of substantiated theory concerning organizational learning and there is considerable need and opportunity to fill in the many gaps.

The third conclusion flies in the face of the normal science paradigm and contributes to the just-noted lack of substantiated theory—the researchers who have studied organizational learning apparently have, to a surprising degree, not used the results from previous research to design or interpret their own research. Another conclusion, also contrary to the advice that scientists frequently give to each other, is that there is little cross-fertilization or synthesis of work done by different research groups or on different but related aspects of organizational learning. (An exception to

this conclusion is that James G. March has made important contributions in a number of areas and has provided a number of integrative works.)

No clear indication exists as to why research on organizational learning has not conformed to recommended practice. Why is there so little cumulative work? Why has so little integration taken place? There are no answers in the literature, but there are clues. One clue is that, in general, the landscape of research on organizational learning is sparsely populated. Consequently, it may be difficult for researchers to find one another in the disparate literatures where their works appear. Further, because there is little agreement on what organizational learning is or how it should be assessed, the encounters that do occur tend not to be fruitful.

A second clue concerning the paucity of cumulative work is found in the review by Levitt and March (1988). Speaking about inter-organizational learning, they observe that:

> Ecologies of learning include various types of interactions among learners (e.g., groups of researchers), but the classical type is a collection of competitors (1988, p. 331).... There is a tendency for organizations (e.g., groups of researchers) to specialize and for faster learners to specialize in inferior technologies (1988, p. 332). (*Parenthetical phrases added.*)

Science-making is a competitive industry, as well as a cooperative one. Scientists tend not to follow in the trails of others if blazing their own trail leads to ownership of part of the landscape. Further, this tendency not to follow the trail of others is exacerbated when lack of agreement on definitions and measures makes the identity of the right trail problematic. Finally, initial success tends to lead to specialization and, while specialization leads to competence and therefore more success, specialization also leads to niches and regions uninhabited by competitors, and so ignorance of the work of others persists. Scientists, like organizations, tend to learn well what they do, and tend to do what they have learned to do well.

What will change this state of affairs? What will lead to work in organizational learning that is cumulative and integrative? One possible answer is exposure to facts and findings from other research groups and streams that can be used to extend the boundaries of one's own work. This paper is an attempt to create such exposure. Another answer, perhaps more compelling, was noted earlier—as the landscape of research on organizational learning becomes more densely populated, much of what an investigator might do might have been done, and so the investigator is compelled to do work closely adjacent to and interfacing with the work of others. Finally, again as the research landscape becomes densely populated, ownership rights become of concern, and researchers are forced by professional norms and journal editors to acknowledge the work of others, and in so doing they will sometimes see ways to capitalize on it. Because the topic of organizational learning is intellectually attractive and of practical importance, it seems quite likely that a denser landscape of studies and researchers will develop, and that this in turn will lead to cumulation and synthesis, and eventually to a rich and elaborate understanding of the phenomenon.

The last conclusion that follows from this examination of organizational learning is of singular importance. With very few exceptions (e.g., the work on organizational self-appraisal and on media richness), work on organizational learning has not led to research-based guidelines for increasing the effectiveness of organizational learning. Nor has it been presented in forums or media typically monitored by those who guide organizational processes. These two conditions certainly seem deserving of attention and remedial action, as organizational adaption and innovation, both critical in a rapidly changing world, could undoubtedly be improved if organizational designers

and administrators knew more about how organizations learn and about how organizations might be guided to learn more effectively.

Acknowledgments

This research was supported in part by the Army Research Institute for the Behavioral and Social Sciences. I am indebted to Janice Beyer, Fred Jablin, David Jemison, Arie Lewin, Reuben McDaniel, Chet Miller, Karl Weick, and Claire Weinstein and the reviewers and Editors of this special issue for their many useful suggestions and constructive comments on earlier drafts of this paper.

References

AGUILAR, F. J. (1967), *Scanning the Business Environment*. New York: Macmillan.

ALLEN, S. A. (1979), "Understanding Reorganizations of Divisionalized Companies," *Academy of Management Journal*, 22, 641–671.

ANSOFF, H. I. (1975), "Managing Strategic Surprise by Response to Weak Signals, *California Management Review*, 18, 21–33.

ARGOTE, L., S. L. BECKMAN AND D. EPPLE, (1990), "The Persistence and Transfer of Learning in Industrial Settings," *Management Science*, 36, 2, 140–154.

ARGYRIS, C. (1982), *Reasoning, Learning, and Action: Individual and Organizational*. San Francisco: Jossey-Bass, Inc.

_____ (1983), "Action Science and Intervention," *Journal of Applied Behavioral Science*, 19, 115–140.

_____ AND D. A. SCHON (1974), *Theory in Practice: Increasing Professional Effectiveness*. San Francisco: Jossey-Bass, Inc.

_____ AND _____ (1978), *Organizational Learning: A Theory of Action Perspective*. Reading, MA: Addison-Wesley Publishing Co.

ASTLEY, W. G. AND A. VAN DE VEN (1983), "Central Perspectives and Debates in Organization Theory," *Administrative Science Quarterly*, 28, 245–273.

BARTUNEK, J. M. (1984), "Changing Interpretive Schemes and Organizational Restructing: The Example of a Religious Order," *Administrative Science Quarterly*, 29, 355–372.

BEER, M. AND A. E. WALTON (1987), "Organization Change and Development," *Annual Review of Psychology*, 38, 339–367.

BEER, S. (1972), *Brain of the Firm*. Hardmondsworth: Allen Lane, Penguin.

BENNIS, W. AND B. NANUS (1985), "Organizational Learning: The Management of the Collective Self," *New Management*, 3, 6–13.

BLANDIN, J. S. AND W. B. BROWN (1977), "Uncertainty and management's search for information," *IEEE Transactions on Management*, EM-24, 114–119.

BOEKER, W. (1988), "Organizational Origins: Entrepreneurial and Environmental Imprinting at Foundling," In G. Carroll (Ed.), *Ecological Models of Organization*. New York: Ballinger.

_____ (1989), "Strategic Change: The Effects of Founding and History," *Academy of Management Journal*, 32, 489–515.

BOULDING, K. E. (1978), *Ecodynamics: A New Theory of Social Evolution*. Beverly Hills, CA: Sage Publications.

BOURGEOIS, L. J., III AND K. M. EISENHARDT (1988), "Strategic Decision Processes in High Velocity Environments: Four Cases in the Microcomputer Industry," *Management Science*, 34, 7, 816–835.

BOWER, G. H. AND E. R. HILGARD (1981), *Theories of Learning*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

BRITTAIN, J. (1989), " Strategy and Time-Dependent Failure Probabilities: Experience, Obsolescence, and Strategic Change," *Academy of Management Proceedings*, 173–177.

BRUNER, J. S. (1957), "On Perceptual Readiness," *Psychological Review*, 64, 132–133.

BURKE, W. W. (1982), *Organization Development: Principles and Practices*. Boston: Little, Brown.

CANGELOSI, V. E. AND W. R. DILL (1965), "Organizational Learning: Observations Toward a Theory," *Administrative Science Quarterly*, 10, 175–203.

CARTER, E. E. (1971), "The Behavioral Theory of the Firm and Top-Level Corporate Decisions," *Administrative Science Quarterly*, 16, 413–428.

CARTER, R. K. (1971), "Client's Resistance to Negative Findings and the Latent Conservative Function of Evaluation Studies," *American Sociologist*, 6, 118–124.

CHAPMAN, R. L., J. L. KENNEDY, A. NEWELL AND C. BIEL (1959), "The Systems Research Laboratory's Air Defense Experiments," *Management Science*, 5, 250–269.

COHEN, M. D. (1981), "The Power of Parallel Thinking," *Journal of Economic Behavior and Organization*, 2, 285–306.

CONNOLLY, T. (1988), "Studies of Information Purchase Processes," In B. Brehmer and C. R. B. Joyce (Eds.), *Human judgement: A Social Judgement Theory*. Amsterdam: North-Holland.

CROZIER, M. (1965), *The Bureaucratic Phenomenon*. New York: Oxford University Press.

CULNAN, M. J. (1983), "Environmental Scanning: The Effects of Task Complexity and Source Accessibility on Information Gathering Behavior," *Decision Sciences*, 14, 194–206.

_____ AND M. L. MARKUS (1987), "Information technologies," In F. M. Jablin, L. L. Putnam, K.H. Roberts and L. W. Porter (Eds.). *Handbook of Organizational Communication*. Newbury Park, CA: Sage Publications.

CYERT, R. M. AND J. G. MARCH (1963), *A Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.

CZEPIEL, J. A. (1975), "Patterns of Interorganizational Communications and the Diffusion of a Major Technological Innovation in a Competitive Industrial Community," *Academy of Management Journal*, 18, 6–24.

DAFT, R. L. AND G. P. HUBER (1987), "How Organizations Learn: A Communication Framework," *Research in the Sociology of Organizations*, 5, 1–36.

_____ AND R. H. LENGEL (1984), "Information Richness: A New Approach to Managerial Behavior and Organization Design," *Research in Organizational Behavior*, 6, 191–233.

_____, _____ AND L. K. TREVINO (1987), "Message Equivocality, Media Selection, and Manager Performance: Implications for Information Systems," *MIS Quarterly*, 11, 355–368.

_____, J. SORMUNEN AND D. PARKS (1988), "Chief Executive Scanning, Environmental Characteristics, and Company Performance: An Empirical Study," *Strategic Management Journal*, 9, 123–139.

_____ AND K. E. WEICK (1984), "Toward a model of organizations as interpretation systems," *Academy of Management Review*, 9, 284–295.

DEARBORN, D. C. AND H. A. SIMON, (1958), "Selective Perception: A Note on the Departmental Identification of Executives," *Sociometry*, 21, 140–144.

DERY, D. (1983), "Decision-Making, Problem-Solving, and Organizational Learning," *Omega*, 11, 321–328.

DILL, W. R. AND N. DOPPELT (1963), "The Acquisition of Experience in a Complex Management Game," *Management Science*, 10, 30–46.

DOLLINGER, M. J. (1984), "Environmental Boundary Spanning and Information Processing Effects on Organizational Performance," *Academy of Management Journal*, 27, 351–368.

DONNELLON, A., B. GRAY AND M. G. BOUGON (1986), "Communication, meaning, and Organized Action," *Administrative Science Quarterly*, 31, 43–55.

DOUGLAS, M. (1986), *How Institutions Think*. Syracuse: Syracuse University Press.

DOWNS, A. (1966), *Inside Bureaucracy*. Boston: Little, Brown.

DRIVER, M. J. AND S. STEUFERT (1969), "Integrative Complexity: An Approach to Individuals and Groups as Information Processing Systems," *Administrative Science Quarterly*, 14, 272–285.

DRUCKER, P. F. (1988), "The Coming of the New Organization," *Harvard Business Review*, 45–53.

DUTTON, J. E, L. FAHEY AND V. K. NARAYANAN (1983), "Toward Understanding Strategic Issue Diagnosis," *Strategic Management Journal*, 4, 307–323.

_____ AND S. E. JACKSON (1987), "Categorizing Strategic Issues: Links to Organizational Action," *Academy of Management Review*, 12, 76–90.

DUTTON, J. M. AND R. D. FREEDMAN (1985), "External Environment and Internal Strategies: Calculating, Experimenting, and Imitating in Organizations," In R. Lamb, and P. Shrivastava (Eds.) *Advances in Strategic Management. Vol. 3*. Greenwich, CT: JAI Press, Inc.

_____, A. THOMAS AND J. E. BUTLER (1984), "The History of Progress Functions as a Managerial Technology," *Business History Review*, 58, 204–233.

EELLS, R. AND P. NEHEMIKS (1984), *Corporate Intelligence and Espionage*. New York: Macmillan.

EISENBERG, E. M. (1984), "Ambiguity as Strategy in Organizational Communication," *Communication Monographs*, 51, 227–242.

_____ AND M. G. WITTEN (1987), " Reconsidering Openness in Organizational Communication," *Academy of Management Review*, 12, 418–426.

EPPLE, D., L. ARGOTE AND R. DEVADAS (1991), "Organizational Learning Curves: A Method for Investigating Intra-Plant Transfer of Knowledge Acquired through Learning by Doing," *Organization Science*, 2.

FAHEY, L. W. R. KING AND V. K. NARAYANAN (1981), "Environmental Scanning and Forecasting in Strategic Planning—The State of the Art," *Long Range Planning*, 14, 32–39.

FARACE, R. V. AND D. MACDONALD (1974), "New Directions in the Study of Organizational Communication," *Personnel Psychology*, 27, 1–19.

FAUCHEUX, C., G. AMADO AND A. LAURENT (1982), "Organizational Development and Change," *Annual Review of Psychology*, 33, 343–370.

FELDMAN, J. AND H. E. KANTER (1965), "Organizational Decision Making," In J. G. March (Ed.), *Handbook of Organizations*. (Chicago: Rand McNally, 614–649).

FELDMAN, M. (1989), *Order without Design: Information Production and Policy Making*. Stanford, CA: Stanford University Press.

_____ AND J. MARCH (1981), "Information in Organizations as Signal and Symbol," *Administrative Science Quarterly*, 26, 171–186.

FIOL, C. M. AND M. A. LYLES (1985), "Organizational Learning," *Academy of Management Review*, 10, 803–813.

FREDICKSON, JAMES W. (1985), "Effects of Decision Motive and Organizational Performance Level on Strategy Decision Processes," *Academy of Management Journal*, 28, 4, 821–843.

FRENCH, W. L. AND C. H. BELL (1990), *Organization Development*. Englewood Cliffs, NJ: Prentice-Hall.

FRIEDLANDER, F. (1983), "Patterns of Individual and Organizational Learning," in S. Srivastva and Associates (Eds.), *The Executive Mind: New Insights on Managerial Thought and Action*. San Francisco: Jossey-Bass.

FULD, L. M. (1988), *Monitoring the Competition: Find Out What's Really Going on Over There*. Somerset, NJ: John Wiley & Sons.

GERSTENFELD, A. AND P. BERGER (1980), "An Analysis of Utilization Differences for Scientific and Technical Information," *Management Science*, 26, 165–179.

GERWIN, D. (1969), "Towards a Theory of Public Budgetary Decision Making," *Administrative Science Quarterly*, 14, 33–46.

GILAD, B. AND T. GILAD (1988), *The Business Intelligence System*. New York: American Management Association.

GIOIA, D. A. AND P. P. POOLE (1984), "Scripts in Organizational Behavior," *Academy of Management Review*, 9, 449–459.

GLUECK, W. (1976), *Business Policy: Strategy Formation and Management Action*. (2nd Ed.). New York: McGraw-Hill.

GUETZKOW, H. (1965), "Communications in Organizations." In J. G. March (Ed.), *Handbook of Organizations*. Chicago: Rand McNally.

HAMBRICK, D. C. (1982), "Environmental Scanning and Organizational Strategy," *Strategic Management Journal*, 3, 159–174.

_____ AND S. FINKELSTEIN (1987), "Managerial Discretion: A Bridge Between Polar Views of Organizational Outcomes," In L. L. Cummings and B. M. Staw (Eds.), *Research in Organizational Behavior*. Greenwich, CT: JAI Press, Inc.

HARRISON, J. R. AND J. G. MARCH (1984), "Decision Making and Postdecision Surprises," *Administrative Science Quarterly*, 29, 26–42.

HAX, A. C. AND N. S. MAJLUF (1988), "The Concept of Strategy and the Strategy Formation Process," *Interfaces*, 19, 99–109.

HEDBERG, B. L. T. (1981), "How Organizations Learn and Unlearn," In P. C., Nystrom and W. H. Starbuck (Eds.), *Handbook of Organizational Design. Volume I*. New York: Oxford University Press.

_____, P. C. NYSTROM AND W. H. STARBUCK (1976), "Camping on Seesaws: Prescriptions for a Self-Designing Organization," *Administration Science Quarterly*, 2, 39–52.

_____, _____ AND _____ (1977), "Designing Organization to Match Tomorrow," In P. C. Nystrom and W. H. Starbuck (Eds.), *Prescriptive Models of Organizations*. Amsterdam: North-Holland.

HERRIOTT, S. R., D. LEVINTHAL AND J. G. MARCH (1985), "Learning from Experience in Organizations," *American Economic Review*, 75, 298–302.

HILTZ, S. R. AND M. TUROFF (1978), *The Network Nation: Human Communication via Computer*. Reading, MA: Addison-Wesley.

HOGARTH, R. M. (1987), *Judgement and Choice*. Chichester: John Wiley & Sons.

HOUSE, R. J. AND J. V. SINGH (1987), "Organizational Behavior: Some New Directions for I/O Psychology," *Annual Review of Psychology*, 38, 669–718.

HUBER, G. P. (1982), "Organizational Information Systems: Determinants of their Performance and Behavior," *Management Science*, 28, 135–155.

_____ (1984),"The Nature and Design of Post-Industrial Organizations," *Management Science*, 30, 928–951.

_____ (1990), "A Theory of the Effects of Advanced Information Technologies on Organizational Design, Intelligence, and Decision Making," *Academy of Management Review*, 15, 47–71.

_____ AND R. L. DAFT (1987), "The Information Environments of Organizations," In F. Jablin, L. Putnam, K. Roberts and L. Porter (Eds.), *Handbook of Organization Communication*. Beverly Hills, CA: Sage.

_____, J. ULLMAN AND R. LEIFER (1979), "Optimum Organization Design: An Analytic-Adoptive Approach," *Academy of Management Review*, 4, 567–578.

IRELAND, R. D., M. A. HITT, R. A. BETTIS AND D. A. DEPORRAS (1987), "Strategy Formulation Processes: Differences in Perceptions of Strength and Weaknesses Indicators and Environmental Uncertainty by Managerial Level," *Strategic Management Journal*, 8, 469–485.

ISABELLA, L. A. (1990), "Evolving Interpretations as a Change Unfolds: How Managers Construe Key Organizational Events," *Academy of Management Journal*, 33, 7–41.

JABLIN, F. M. (1984), "Assimilating New Members into Organizations." *Communication Yearbook*, 8.

_____ (1987), "Organizational Entry, Assimilation, and Exit," In F. Jablin, L. Putnam, K. Roberts, and L. Porter (Eds.), *Handbook of Organization Communication*. Beverly Hills, CA: Sage.

JANIS, I. L. (1972), *Victims of Groupthink*. Boston: Houghton Mifflin.

JELINEK, M. (1979), *Institutionalizing Innovation: A Study of Organizational Learning Systems*. New York: Praeger Publishers, Inc.

JEMISON, D. B. (1984), "The Importance of Boundary-Spanning Roles in Strategic Decision Making," *Journal of Management Studies*, 21, 131–152.

_____ AND S. B. SITKIN (1986), "Corporate Acquisitions: A Process Perspective," *Academy of Management Review*, 11, 145–163.

JOHANSEN, R. (1988), *Groupware: Computer Support for Business Teams*. New York: Free Press.

JOSKOW, P. L. AND N. L. ROSE (1985), "The Effects of Technological Change, Experience, and Environmental Regulation on the Construction Cost of Coal-Burning Generating Units," *Rand Journal of Economics*, 16, 1–27.

KAHNEMAN, D. P. SLOVIC AND A. TVERSKY (1982), *Judgement under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge Univ. Press.

KEEGAN, W. J. (1974), "Multinational Scanning: A Study of Information Sources Utilized by Headquarters Executives in Multinational Companies," *Administrative Science Quarterly*, 19, 411–421.

KENNEDY, M. M. (1983), "Working Knowledge," *Knowledge: Creation, Diffusion, Utilization*, 5, 193–211.

KIESLER, S., J. SIEGEL AND J. W. MCGUIRE (1984), "Social Psychological Aspects of Computer-Mediated Communication," *American Psychologist*, 39, 1123–1134.

KIMBERLY, J. R. (1979), "Issues in the Creation of Organizations: Initiation, Innovation, and Institutionalization," *Academy of Management Journal*, 22, 437–457.

KLEIN, J. I. (1989), "Parenthetic Learning in Organizations: Toward the Unlearning of the Unlearning Model," *Journal of Management Studies*, 26, 291–308.

KRONE, K. J., F. M. JABLIN AND L. L. PUTNAM (1987), "Communication theory and organizational communication: Multiple perspectives," In F. M. Jablin, L. L. Putnam, K. H. Roberts and L. W. Porter (Eds.), *Handbook of Organizational Communication*. Newbury Park, CA: Sage Publications.

KURKE, L. B. AND H. B. ALDRICH (1983), "Mintzberg Was Right!: A Replication and Extension of the Nature of Managerial Work," *Management Science*, 29, 975–984.

LANDAU, M. (1973), "On the Concept of a Self-Correcting Organization," *Public Administration Review*, 33, 533–542.

LAWLER, E. E., III (1977), "Adaptive Experiments: An Approach to Organizational Behavior Research," *Academy of Management Review*, 2, 567–585.

LEIFER, R. AND G. P. HUBER (1977), "Relations among Perceived Environmental Uncertainty, Organization Structure, and Boundary-Spanning Behavior," *Administrative Science Quarterly*, 22, 235–247.

LEVINTHAL, D. AND J. G. MARCH (1981), "A Model of Adaptive Organizational Search," *Journal of Economic Behavior and Organization*, 2, 307–333.

_____ AND D. A. YAO (1988), "The Search for Excellence: Organizational Inertia and Adaption," Unpublished manuscript, in press.

LEVITT, B. AND J. G. MARCH (1988), "Organizational Learning," *Annual Review of Sociology*, 14, 319–340.

LEWIN, K. (1951), *Field Theory in Social Science*. New York: Harper & Row.

LINDBLOM, C. E. (1959), "The Science of Muddling Through," *Public Administration Review*, 19, 78–88.

LOUNAMAA, P. H. AND J. G. MARCH (1987), "Adaptive coordination of a learning team," *Management Science*, 33, 107–123.

LYLES, M. A. (1988), "Learning among Joint-Venture Sophisticated Firms," *Management International Review*, 28, 85–98.

MACNAMARA, M. AND W. H. WEEKS (1982), "The action learning model of experiential learning for developing managers," *Human Relations*, 35, 879–902.

MAHAJAN, V., S. SHARMA AND R. A. BETTIS (1988), "The Adoption of the *M*-Form Organizational Structure: A Test of Imitation Hypothesis," *Management Science*, 34, 1188–1201.

MARCH, J. G. (1981), "Decision in Organizations and Theories of Choice," In A. H. Van de Ven and W. Joyce (Eds.), *Perspectives on Organization Design and Behavior*. New York: Wiley.

_____ AND J. P. OLSEN (1979), *Ambiguity and Choice in Organizations*, (2nd Ed.) Bergen: Universitetsforlaget.

MARCH, J. G. AND G. SEVON (1984), "Gossip, information, and decision making," In L. S. Sproull and P. D. Larkey (Eds.), *Advances in Information Processing in Organizations*. Vol. 1. Greenwich, CT: JAI Press.

_____, L. S. SPROULL AND M. TAMUZ (1991), "Learning from Samples of One or Fewer." *Organization Science*, 2.

MEIER, R. L. (1963), "Communications Overload: Proposals from the Study of a University Library," *Administrative Science Quarterly*, 4, 521–544.

MEYER, J. W. AND B. ROWAN (1977), "Institutionalized Organizations: Formal Structure as Myth and Ceremony," *American Journal of Sociology*, 83, 440–463.

MILES, R. H. AND W. A. RANDOLPH (1980), "Influence of Organizational Learning Styles on Early Development," In J. R. Kimberly and R. H. Miles (Eds.), *The Organizational Life Cycle*. San Francisco: Jossey-Bass.

MILLER, D. AND P. H. FRIESEN (1980a), "Archetypes of Organizational Transition," *Administrative Science Quarterly*, 25, 268–299.

_____ AND _____ (1980b), "Momentum and Revolution in Organizational Adaption," *Academy of Management Journal*, 25, 591–614.

MILLER, J. G. (1978), *Living Systems*. New York: McGraw-Hill Book Company.

MILLIKEN, F. J. (1990), "Perceiving and Interpreting Environmental Change: An Examination of College Administrators' Interpretation of Changing Demographics," *Academy of Management Journal*, 33, 42–63.

MINTZBERG, H. (1975), "The Manager's Job: Folklore and Fact," *Harvard Business Review*, 53, 49–61.

_____ AND A. MCHUGH (1985), "Strategy Formation in an Adhocracy," *Administrative Science Quarterly*, 30, 160–197.

_____, D. RAISINGHANI AND A. THEORET (1976), "The Structure of 'Unstructured' Decision Processes," *Administrative Science Quarterly*, 21, 246–275.

MODY, A. (1989), "Firm Strategies for Costly Engineering Learning," *Management Science*, 35, 496–512.

MORGAN, G. (1986), *Images of Organizations*. Beverly Hills, CA: Sage.

MUTH, J. F. (1986), "Search Theory and the Manufacturing Progress Function," *Management Science*, 32, 948–962.

NELSON, R. AND S. WINTER (1982), *An Evolutionary Theory of Economic Change*. Cambridge, MA: The Bellhop Press of Harvard University Press.

NEWMAN, M. (1985), "Managerial Access to Information: Strategies for Prevention and Promotion," *Journal of Management Studies*, 22, 193–212.

NISBETT, R. AND L. ROSS (1980), *Human Inference: Strategies and Shortcomings of Social Judgement*. Englewood Cliffs, NJ: Prentice-Hall.

NONAKA, I. (1988), "Creating Organizational Order out of Chaos: Self-Renewal in Japanese Firms," *California Management Review*, 30, 57–73.

NUTT, P. C., (1986), "Decision Style and Strategic Decisions of Top Executives," *Technological Forecasting and Social Change*, 30, 39–62.

NYSTROM, P. C. B. L. T. HEDBERG AND W. H. STARBUCK (1976), "Interacting Processes as Organizational Designs," In R. H. Kilman, L. R. Pondy and D. P. Slevin (Eds.), *The Management of Organization Designs*. Amsterdam: North-Holland.

_____ AND W. STARBUCK (1984), "To Avoid Organizational Crises, Unlearn," *Organizational Dynamics*, 13, 53–65.

O'REILLY, C. (1982), "Variations in Use of Decision Makers' Use of Information Sources: The Impact of Quality versus Accessibility of Information," *Academy of Management Journal*, 25, 756–771.

_____ AND L. PONDY (1980),"Organizational Communication," In S. Kerr (Ed.), *Organizational Behavior*. Columbus, OH: Grid.

OUCHI, W. G. (1984), *The M-Form Society*. New York: Avon Books.

PARIS, S. G., M. Y. LIPSON AND K. K. WIXSON (1983), "Becoming a Strategic Reader," *Contemporary Educational Psychology*, 8, 293–316.

PETERS, M. AND V. ROBINSON (1984), "The Origins and Status of Action Research," *Journal of Applied Behavioral Science*, 20, 113–124.

PETERS, T. (1987), *Thriving on Chaos*. New York: Harper and Row.

PORTER, L. W. AND K. H. ROBERTS (1976), "Communications in Organizations," In M. D. Dunnette (Ed.), *Handbook of Industrial and Organizational Psychology*. Chicago: Rand NcNally.

PORTER, M. E. (1980), *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.

QUINN, J. B. (1980), *Strategies for Change: Logical Incrementalism*. Homewood, IL: Irwin.

RAO, H. R. AND B. P. LINGARAJ (1988), "Expert Systems in Production and Operations Management." *Interfaces*, 18, 80–91.

RAUCH-HINDIN, W. B. (1988), *A Guide to Commercial Artificial Intelligence*. Englewood Cliffs, NJ: Prentice Hall.

REITZEL, W. A. (1958), *Background to Decision Making*. Newport, RI: U.S. Naval War College.

ROSSI, P. H. AND H. E. FREEMAN (1989), *Evaluation: A Systematic Approach*. Newbury Park, CA: Sage Publications, Inc.

SABATIER, P. (1978), "The Acquisition and Utilization of Technical Information by Administrative Agencies," *Administrative Science Quarterly*, 23, 396–417.

SAHAL, D. (1982), *The Transfer and Utilization of Technical Knowledge*. Lexington, MA: Lexington Books.

SALANCIK, GERALD R. AND JEFFREY PFEFFER (1978), "A Social Information Processing Approach to Job Attitudes and Task Design," *Administrative Science Quarterly*, 23, 224–253.

SAMMON, W. L., M. A. KURLAND AND R. SPITALNIC (1984), *Business Competitor Intelligence: Methods for Collecting, Organizing, and Using Information*. New York: John Wiley & Sons.

SANDELANDS, L. E. AND R. E. STABLEIN (1987), "The Concept of Organization Mind," *Research in the Sociology of Organizations*, 5, 135–162.

SCHEIN, E. H. (1984), "Coming to a New Awareness of Organizational Culture," *Sloan Management Review*, 12, 1, 3–16.

SCHLESINGER, J. R. (1970), *Planning, Programming, Budgeting, Inquiry of the Subcommittee on National Security and International Operations for the Senate Committee on Government Operations*, 91 Cong. 1 Sess., 482.

SCHWAB, R. C., G. R. UNGSON AND W. B. BROWN (1985), "Redefining the Boundary Spanning-Environment Relationship," *Journal of Management*, 11, 75–86.

SCHWENK, C. R. (1984), "Cognitive Simplification Processes in Strategic Decision Making," *Strategic Management Journal*, 5, 111–128.

SHORT, J., E. WILLIAMS AND B. CHRISTIE (1976), *The Social Psychology of Telecommunications*. New York: John Wiley.

SHRIVASTAVA, P. (1983), "A Typology of Organizational Learning Systems," *Journal of Management Studies*, 20, 1–28.

_____ AND S. SCHNEIDER (1984), "Organizational Frames of Reference," *Human Relations*, 37, 795–809.

SIMON, H. A. (1973), "Applying Information Technology to Organization Design," *Public Administration Review*, 33, 268–278.

SIMS, H. P., JR., D. A. GIOIA AND ASSOCIATES (1986), *The Thinking Organization*. San Francisco: Jossey-Bass Publications.

SITKIN, S. B. (forthcoming). "Learning through Failure: the Strategy of Small Losses," In B. M. Staw and L. L. Cummings (Eds.), *Research in Organizational Behavior*, Greenwich, CT: JAI Press, Inc. To appear in Vol. 14, 1992.

SPROULL, L. S. (1981), "Beliefs in Organizations," In P. C. Nystrom and W. H. Starbuck (Eds.), *Handbook of organizational design*. Vol. 2. New York: Oxford University Press.

STARBUCK, W. H. (1984), "Organizations as Action Generators," *American Sociological Review*, 48, 91–102.

_____ AND F. J. MILLIKEN (1988), "Executives' Perceptual Filters: What They Notice and How They Make Sense," in D. Hambrick (Ed.), *The Executive Effect: Concepts and Methods for Studying Top Managers*. Greenwich, CT: JAI Press, 35–66.

STRAW, B. M. (1977), "The Experimenting Organization: Problems and Prospects," In *Psychological Foundations of Organization Behavior*. Pacific Palisades, CA: Goodyear.

_____ AND J. ROSS (1987), Behavior in escalation situations: Antecedents, prototypes, and solutions. In L.L. Cummings and B. M. Staw (Eds.), *Research in Organizational Behavior*. Vol. 9, 39–78.

STINCHCOMBE, A. L. (1965), "Social Structure and Organizations," In J. G. March (Ed.), *Handbook of Organizations*. Chicago: Rand McNally.

THAYER, L. (1967), "Communication and Organization Theory," In F. E. X. Dance (Ed.), *Human Communication Theory: Original Essays*. New York: Holt, Rinehart, and Winston.

TRIST, E. (1983), "Referent-Organizations and the Development of Inter-Organizational Domains," *Human Relations*, 36, 269–284.

TUNSTALL, W. B. (1983), "Cultural Transition at AT & T," *Sloan Management Review*, 25, 18.

TUSHMAN, M. L. (1977), "Communications across Organizational Boundaries: Special Boundary Roles in the Innovation Process," *Administrative Science Quarterly*, 22, 587–605.

_____ AND R. KATZ (1980), "External Communication and Project Performance: An Investigation into the Role of Gatekeepers," *Management Science*, 26, 1071–1085.

_____ AND W. L. MOORE (Eds.) (1988), *Readings in the Management of Innovation*. Cambridge, MA: Ballinger Publishing Company.

_____ AND E. ROMANELLI (1985), "Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation," In L. L. Cummings and B. M. Staw (Eds.), *Research in Organizational Behavior*, Vol. 7. Greenwich, CT: JAI Press, Inc.

TUSHMAN AND T. J. SCALAN (1981), "Boundary-Spanning Individuals: Their Role in Information Transfer and Their Antecedents," *Academy of Management Journal*, 24, 289–305.

TVERSKY, A. AND D. KAHNEMAN (1985), "The Framing of Decisions and the Psychology of Choice," In G. Wright (Ed.), *Behavioral Decision Making*. New York: Plenum Press.

WALKER, G. (1985), "Network Position and Cognition in a Computer Software Firm," *Administrative Science Quarterly*, 30, 103–130.

WALSH, J. P. AND G. R. UNGSON (1991), "Organizational Memory," *Academy of Management Review*.

WARNER, M. (1981), "Organizational Experiments and Social Innovations," In P. C. Nystrom and W. H. Starbuck (Eds.), *Handbook of organizational design*. Vol. 1. New York: Oxford University Press.

_____ (1984), *Organizations and Experiments*. New York: Wiley.

WATERMAN, D. A. (1986), *A Guide to Expert Systems*. Reading, MA: Addison-Wesley.

WEBER, C. E. (1965), "Intraorganizational Decision Processes Influencing the EDP Staff Budget," *Management Science*, 13, 69–93.

WEBSTER'S NEW COLLEGIATE DICTIONARY. (1977), Springfield, MA: G.& C. Merriam Company.

WEICK, K. E. (1979), "Cognitive Processes in Organizations," *Research in Organizational Behavior*, 1, 41–74.

_____ AND M. G. BOUGON (1986), "Organizations as Cognitive Maps: Charting ways to Success and Failure," In H. P. Sims, Jr., D. A. Gioia and Associates, *The Thinking Organization*, San Francisco: Jossey-Bass Publishers.

WEISS, C. H. (1973), *Evaluating Action Programs: Readings in Social Action and Education*. Boston: Allyn and Bacon.

_____ (1980), "Knowledge Creep and Decision Accretion," *Knowledge: Creation, Diffusion, Utilization*, 1, 381–404.

WELBANK, M. (1983), *A Review of Knowledge Acquisition Techniques for Expert Systems*. Ipswich, England: Martlesham Consultancy Services.

WILDAVSKY, A. (1972), "The Self-Evaluating Organization," *Public Administration Review*, 32, 509–520.

YATES, J. (1990), "For the Record: The Embodiment of Organizational Memory, 1850–1920," Paper presented at the Business History Conference, 1990.

YELLE, L. E. (1979), "The Learning Curve: Historical Review and Comprehensive Survey," *Decision Sciences*, 10, 302–308.

ZAJONC, R. AND D. WOLFE (1966), "Cognitive Consequences of a Person's Position in a Formal Organization," *Human Relations*, 19, 139–150.

ZIMMERMAN, M. B. (1982), "Learning Effects and the Commercialization of New Energy Technologies: The Case of Nuclear Power," *Bell Journal of Economics*, 13, 297–310.

ZUCKER, L. G. (1987), "Institutional Theories of Organization," *Annual Review of Sociology*, 13, 443–464.