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ORGANIZATIONAL LEARNING

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Abstract

This paper reviews the literature on organizational learning. Organizational learning is viewed as routine-based, history-dependent, and target-oriented. Organizations are seen as learning by encoding inferences from history into routines that guide behavior. Within this perspective on organizational learning, topics covered include how organizations learn from direct experience, how organizations learn from the experience of others, and how organizations develop conceptual frameworks or paradigms for interpreting that experience. The section on organizational memory discusses how organizations encode, store, and retrieve the lessons of history despite the turnover of personnel and the passage of time. Organizational learning is further complicated by the ecological structure of the simultaneously adapting behavior of other organizations, and by an endogenously changing environment. The final section discusses the limitations as well as the possibilities of organizational learning as a form of intelligence.

INTRODUCTION

Theories of organizational learning can be distinguished from theories of analysis and choice which emphasize anticipatory calculation and intention (Machina 1987), from theories of conflict and bargaining which emphasize strategic action, power, and exchange (Pfeffer 1981), and from theories of variation and selection which emphasize differential birth and survival rates of invariant forms (Hannan & Freeman 1977). Although the actual behavioral processes and mechanisms of learning are sufficiently intertwined with choice, bargaining, and selection to make such theoretical distinctions artificial at times, ideas about organizational learning are distinct from, and framed by, ideas about the other processes (Grandori 1987, Scott 1987).

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Our interpretation of organizational learning builds on three classical observations drawn from behavioral studies of organizations. The first is that behavior in an organization is based on routines (Cyert & March 1963, Nelson & Winter 1982). Action stems from a logic of appropriateness or legitimacy more than from a logic of consequentiality or intention. It involves matching procedures to situations more than it does calculating choices. The second observation is that organizational actions are history-dependent (Lindblom 1959, Steinbruner 1974). Routines are based on interpretations of the past more than anticipations of the future. They adapt to experience incrementally in response to feedback about outcomes. The third observation is that organizations are oriented to targets (Simon 1955, Siegel 1957). Their behavior depends on the relation between the outcomes they observe and the aspirations they have for those outcomes. Sharper distinctions are made between success and failure than among gradations of either.

Within such a framework, organizations are seen as learning by encoding inferences from history into routines that guide behavior. The generic term "routines" includes the forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate. It also includes the structure of beliefs, frameworks, paradigms, codes, cultures, and knowledge that buttress, elaborate, and contradict the formal routines. Routines are independent of the individual actors who execute them and are capable of surviving considerable turnover in individual actors.

The experiential lessons of history are captured by routines in a way that makes the lessons, but not the history, accessible to organizations and organizational members who have not themselves experienced the history. Routines are transmitted through socialization, education, imitation, professionalization, personnel movement, mergers, and acquisitions. They are recorded in a collective memory that is often coherent but is sometimes jumbled, that often endures but is sometimes lost. They change as a result of experience within a community of other learning organizations. These changes depend on interpretations of history, particularly on the evaluation of outcomes in terms of targets.

In the remainder of the present paper we examine such processes of organizational learning. The perspective is narrower than that used by some (Starbuck 1976, Hedberg 1981, Fiol & Lyles 1985) and differs conceptually from that used by others. In particular, both the emphasis on routines and the emphasis on ecologies of learning distinguish the present formulation from treatments that deal primarily with individual learning within single organizations (March & Olsen 1975, Argyris & Schön 1978) and place this paper closer to the traditions of behavioral theories of organizational decision-making (Winter 1986, House & Singh 1987), and to population level theories of organizational change (Carroll 1984, Astley 1985).

LEARNING FROM DIRECT EXPERIENCE

Routines and beliefs change in response to direct organizational experience through two major mechanisms. The first is trial-and-error experimentation. The likelihood that a routine will be used is increased when it is associated with success in meeting a target, decreased when it is associated with failure (Cyert & March 1963). The underlying process by which this occurs is left largely unspecified. The second mechanism is organizational search. An organization draws from a pool of alternative routines, adopting better ones when they are discovered. Since the rate of discovery is a function both of the richness of the pool and of the intensity and direction of search, it depends on the history of success and failure of the organization (Radner 1975).

Learning by Doing

The purest example of learning from direct experience is found in the effects of cumulated production and user experience on productivity in manufacturing (Dutton et al 1984). Research on aircraft production, first in the 1930s (Wright 1936) and subsequently during World War II (Asher 1956), indicated that direct labor costs in producing airframes declined with the cumulated number of airframes produced. If C_i is the direct labor cost of the ith airframe produced, and a is a constant, then the empirical results are approximated by: $C_n = C_1 n^{-a}$. This equation, similar in spirit and form to learning curves in individuals and animals, has been shown to fit production costs (in constant dollars) reasonably well in a relatively large number of products, firms, and nations (Yelle 1979). Much of the early research involved only simple graphical techniques, but more elaborate analyses have largely confirmed the original results (Rapping 1965). Estimates of the learning rate, however, vary substantially across industries, products, and time (Dutton & Thomas 1984).

Empirical plots of experience curves have been buttressed by three kinds of analytical elaborations. First, there have been attempts to decompose experience curves into several intercorrelated causes and to assess their separate contributions to the observed improvements in manufacturing costs. Although it has been argued that important elements of the improvements come through feedback from customers who use the products, particularly where those products are complex (Rosenberg 1982), most of the research on experience curves has emphasized the direct effects of cumulative experience on production skills. Most studies indicate that the effects due to cumulative production are greater than those due to changes in the current scale of production, transformation of the technology, increases in the experience of individual production workers, or the passage of time (Preston & Keachie 1964, Hollander 1965, Argote et al 1987); but there is evidence that the latter effects are also involved (Dutton & Thomas 1984, 1985). Second, there have been attempts to use experience curves as a basis for pricing strategies. These

efforts have led to some well-publicized successes but also to some failures attributable to an inadequate specification of the basic model, particularly as it relates to the sharing of experience across organizations (Day & Montgomery 1983, Dutton & Freedman 1985). Third, there have been attempts to define models that not only predict the general log-linear result but also accommodate some of the small but theoretically interesting departures from that curve (Muth 1986). These efforts are, for the most part, variations on themes of trial-and-error learning or organizational search.

Competency Traps

In simple discussions of experiential learning based on trial-and-error learning or organizational search, organizations are described as gradually adopting those routines, procedures, or strategies that lead to favorable outcomes; but the routines themselves are treated as fixed. In fact, of course, routines are transformed at the same time as the organization learns which of them to pursue, and discrimination among alternative routines is affected by their transformations (March 1981, Burgelman 1988).

The dynamics are exemplified by cases in which each routine is itself a collection of routines, and learning takes place at several nested levels. In such multilevel learning, organizations learn simultaneously both to discriminate among routines and to refine the routines by learning within them. A familiar contemporary example is the way in which organizations learn to use some software systems rather than others and simultaneously learn to refine their skills on the systems that they use. As a result of such learning, efficiency with any particular procedure increases with use, and differences in success with different procedures reflect not only differences in the performance potentials of the procedures but also an organization's current competences with them.

Multilevel learning typically leads to specialization. By improving competencies within frequently used procedures, it increases the frequency with which those procedures result in successful outcomes and thereby increases their use. Provided this process leads the organization both to improve the efficiency and to increase the use of the procedure with the highest potential, specialization is advantageous. However, a competency trap can occur when favorable performance with an inferior procedure leads an organization to accumulate more experience with it, thus keeping experience with a superior procedure inadequate to make it rewarding to use. Such traps are well-known both in their new technology version (Cooper & Schendel 1976) and in their new procedures version (Zucker 1977).

Competency traps are particularly likely to lead to maladaptive specialization if newer routines are better than older ones. One case is the sequential exposure to new procedures in a developing technology (Barley 1988). Later

procedures are improvements, but learning organizations have problems in overcoming the competences they have developed with earlier ones (Whetten 1987). The likelihood of such persistence in inferior procedures is sensitive to the magnitude of the difference between the potentials of the alternatives. The status quo is unlikely to be stable if the differences in potential between existing routines and new ones are substantial (Stinchcombe 1986). The likelihood of falling into a competency trap is also sensitive to learning rates. Fast learning among alternative routines tends to increase the risks of maladaptive specialization, while fast learning within a new routine tends to decrease the risks (Herriott et al 1985).

The broader social and evolutionary implications of competency traps are considerable. In effect, learning produces increasing returns to experience (thus typically to scale) and leads an organization, industry, or society to persist in using a set of procedures or technologies that may be far from optimal (Arthur 1984). Familiar examples are the standard typewriter keyboard and the use of the internal combustion gasoline engine to power motor vehicles. Since they convert almost chance actions based on small differences into stable arrangements, competency traps result in organizational histories for which broad functional or efficiency explanations are often inadequate.

INTERPRETATION OF EXPERIENCE

The lessons of experience are drawn from a relatively small number of observations in a complex, changing ecology of learning organizations. What has happened is not always obvious, and the causality of events is difficult to untangle. What an organization should expect to achieve, and thus the difference between success and failure, is not always clear. Nevertheless, people in organizations form interpretations of events and come to classify outcomes as good or bad (Thompson 1967).

Certain properties of this interpretation of experience stem from features of individual inference and judgment. As has frequently been observed, individual human beings are not perfect statisticians (Kahneman et al 1982). They make systematic errors in recording the events of history and in making inferences from them. They overestimate the probability of events that actually occur and of events that are available to attention because of their recency or saliency. They are insensitive to sample size. They tend to overattribute events to the intentional actions of individuals. They use simple linear and functional rules, associate causality with spatial and temporal contiguity, and assume that big effects must have big causes. These attributes of individuals as historians are important to the present topic because they lead to systematic biases in interpretation, but they are reviewed in several previous publications (Slovic et al 1977, Einhorn & Hogarth 1986, Starbuck & Milliken 1988) and are not discussed here.

Stories, Paradigms, and Frames

Organizations devote considerable energy to developing collective understandings of history. These interpretations of experience depend on the frames within which events are comprehended (Daft & Weick 1984). They are translated into, and developed through, story lines that come to be broadly, but not universally, shared (Clark 1972, Martin et al 1985). This structure of meaning is normally suppressed as a conscious concern, but learning occurs within it. As a result, some of the more powerful phenomena in organizational change surround the transformation of givens, the redefinition of events, alternatives, and concepts through consciousness raising, culture building, double-loop learning, or paradigm shifts (Argyris & Schön 1978, Brown 1978, Beyer 1981).

It is imaginable that organizations will come to discard ineffective interpretive frames in the very long run, but the difficulties in using history to discriminate intelligently among alternative paradigms are profound. Where there are multiple, hierarchically arranged levels of simultaneous learning, the interactions among them are complex, and it is difficult to evaluate higher order alternatives on the basis of experience. Alternative frames are flexible enough to allow change in operational routines without affecting organizational mythology (Meyer & Rowan 1977, Krieger 1979), and organizational participants collude in support of interpretations that sustain the myths (Tirole 1986). As a result, stories, paradigms, and beliefs are conserved in the face of considerable potential disconfirmation (Sproull 1981); and what is learned appears to be influenced less by history than by the frames applied to that history (Fischoff 1975, Pettigrew 1985).

Although frameworks for interpreting experience within organizations are generally resistant to experience—indeed, may enact that experience (Weick 1979)—they are vulnerable to paradigm peddling and paradigm politics. Ambiguity sustains the efforts of theorists and therapists to promote their favorite frameworks, and the process by which interpretations are developed makes it relatively easy for conflicts of interest within an organization to spawn conflicting interpretations. For example, leaders of organizations are inclined to accept paradigms that attribute organizational successes to their own actions and organizational failures to the actions of others or to external forces, but opposition groups in an organization are likely to have the converse principle for attributing causality (Miller & Ross 1975). Similarly, advocates of a particular policy, but not their opponents, are likely to interpret failures less as a symptom that the policy is incorrect than as an indication that it has not been pursued vigorously enough (Ross & Staw 1986). As a result, disagreements over the meaning of history are possible, and different groups develop alternative stories that interpret the same experience quite differently.

The Ambiguity of Success

Both trial-and-error learning and incremental search depend on the evaluation of outcomes as successes or failures. There is a structural bias toward post-decision disappointment in ordinary decision-making (Harrison & March 1984), but individual decisionmakers often seem to be able to reinterpret their objectives or the outcomes in such a way as to make themselves successful even when the shortfall seems quite large (Staw & Ross 1978).

The process is similar in organizational learning, particularly where the leadership is stable and the organization is tightly integrated (Ross & Staw 1986). But where such conditions do not hold, there are often differences stemming from the political nature of an organization. Goals are ambiguous, and commitment to them is confounded by their relation to personal and subgroup objectives (Moore & Gates 1986). Conflict and decision advocacy within putatively rational decision processes lead to inflated expectations and problems of implementation and thus to disappointments (Olsen 1976, Sproull et al 1978). Different groups in an organization often have different targets and evaluate the same outcome differently. Simple euphoria is constrained by the presence of individuals and groups who opposed the direction being pursued, or who at least feel no need to accept responsibility for it (Brunsson 1985). New organizational leaders are inclined to define previous outcomes more negatively than are the leaders who preceded them (Hedberg 1981). As a result, evaluations of outcomes are likely to be more negative or more mixed in organizations than they are in individuals.

Organizational success is ordinarily defined in terms of the relation between performance outcomes and targets. Targets, however, change over time in two ways. First, the indicators of success are modified. Accounting definitions change (Burchell et al 1985); social and policy indicators are redefined (MacRae 1985). Second, levels of aspiration with respect to any particular indicator change. The most common assumption is that a target is a function of some kind of moving average of past achievement, the gap between past achievement and past targets, or the rate of change of either (Cyert & March 1963, Lant 1987).

Superstitious Learning

Superstitious learning occurs when the subjective experience of learning is compelling, but the connections between actions and outcomes are misspecified. Numerous opportunities exist for such misunderstandings in learning from experience in organizations. For example, it is easy for technicians to develop superstitious perceptions of a new technology from their experience with it (Barley 1988). Cases of superstition that are of particular interest to students of organizations are those that stem from special features of life in hierarchical organizations. For example, the promotion of managers on the

basis of performance produces self-confidence among top executives that is partly superstitious, leading them to overestimate the extent to which they can control the risks their organizations face (March & Shapira 1987).

Superstitious learning often involves situations in which subjective evaluations of success are insensitive to the actions taken. During very good times, or when post-outcome euphoria reinterprets outcomes positively, or when targets are low, only exceptionally inappropriate routines will lead an organization to experience failure. In like manner, during very bad times, or when post-outcome pessimism reinterprets outcomes negatively, or when targets are high, no routine will lead to success. Evaluations that are insensitive to actions can also result from adaptive aspirations. Targets that adapt very rapidly will be close to the current performance level. This makes being above or below the target an almost chance event. Very slow adaptation, on the other hand, is likely to keep an organization either successful for long periods of time or unsuccessful for long periods of time. A similar result is realized if targets adapt to the performance of other organizations. For example, if each firm in an industry sets its target equal to the average performance of firms in that industry, some firms are likely to be persistently above the target and others persistently below (Levinthal & March 1981, Herriott et al 1985).

Each of these situations produces superstitious learning. In an organization that is invariantly successful, routines that are followed are associated with success and are reinforced; other routines are inhibited. The organization becomes committed to a particular set of routines, but the routines to which it becomes committed are determined more by early (relatively arbitrary) actions than by information gained from the learning situation (Nystrom & Starbuck 1984). Alternatively, if failure is experienced regardless of the particular routine that is used, routines are changed frequently in a fruitless search for some that work. In both cases, the subjective feeling of learning is powerful, but it is misleading.

ORGANIZATIONAL MEMORY

Organizational learning depends on features of individual memories (Hastie et al 1984, Johnson & Hasher 1987), but our present concern is with organizational aspects of memory. Routine-based conceptions of learning presume that the lessons of experience are maintained and accumulated within routines despite the turnover of personnel and the passage of time. Rules, procedures, technologies, beliefs, and cultures are conserved through systems of socialization and control. They are retrieved through mechanisms of attention within a memory structure. Such organizational instruments not only record history but shape its future path, and the details of that path depend significantly on the processes by which the memory is maintained and consulted. An

accounting system, whether viewed as the product of design or the residue of historical development, affects the recording and creation of history by an organization (Johnson & Kaplan 1987, Røvik 1987). The ways in which military routines are changed, maintained, and consulted contribute to the likelihood and orchestration of military engagement (Levy 1986).

Recording of Experience

Inferences drawn from experience are recorded in documents, accounts, files, standard operating procedures, and rule books; in the social and physical geography of organizational structures and relationships; in standards of good professional practice; in the culture of organizational stories; and in shared perceptions of "the way things are done around here." Relatively little is known about the details by which organizational experience is accumulated into a structure of routines, but it is clearly a process that yields different kinds of routines in different situations and is only partly successful in imposing internal consistency on organizational memories.

Not everything is recorded. The transformation of experience into routines and the recording of those routines involve costs. The costs are sensitive to information technology, and a common observation is that modern computer-based technology encourages the automation of routines by substantially reducing the costs of recording them. Even so, a good deal of experience is unrecorded simply because the costs are too great. Organizations also often make distinction between outcomes that will be considered relevant for future actions and outcomes that will not. The distinction may be implicit, as for example when comparisons between projected and realized returns from capital investment projects are ignored (Hägg 1979). It may be explicit, as for example when exceptions to the rules are declared not to be precedents for the future. By creating a set of actions that are not precedents, an organization gives routines both short-term flexibility and long-term stability (Powell 1986).

Organizations vary in the emphasis placed on formal routines. Craft-based organizations rely more heavily on tacit knowledge than do bureaucracies (Becker 1982). Organizations facing complex uncertainties rely on informally shared understandings more than do organizations dealing with simpler, more stable environments (Ouchi 1980). There is also variation within organizations. Higher level managers rely more on ambiguous information (relative to formal rules) than do lower level managers (Daft & Lengel 1984).

Experiential knowledge, whether in tacit form or in formal rules, is recorded in an organizational memory. That memory is orderly, but it exhibits inconsistencies and ambiguities. Some of the contradictions are a consequence of inherent complications in maintaining consistency in inferences drawn sequentially from a changing experience. Some, however, reflect

differences in experience, the confusions of history, and conflicting interpretations of that history. These latter inconsistencies are likely to be organized into deviant memories, maintained by subcultures, subgroups, and subunits (Martin et al 1985). With a change in the fortunes of the dominant coalition, the deviant memories become more salient to action (Martin & Siehl 1983).

Conservation of Experience

Unless the implications of experience can be transferred from those who experienced it to those who did not, the lessons of history are likely to be lost through turnover of personnel. Written rules, oral transitions, and systems of formal and informal apprenticeships implicitly instruct new individuals in the lessons of history. Under many circumstances, the transfer of tradition is relatively straightforward and organizational experience is substantially conserved. For example, most police officers are socialized successfully to actions and beliefs recognizable as acceptable police behavior, even in cases where those actions and beliefs are substantially different from those that were originally instrumental in leading an individual to seek the career (Van Maanen 1973).

Under other circumstances, however, organizational experience is not conserved. Knowledge disappears from an organization's active memory (Neustadt & May 1986). Routines are not conserved because of limits on the time or legitimacy of the socializing agents, as for example in deviant subgroups or when the number of new members is large (Sproull et al 1978); because of conflict with other normative orders, as for example with new organization members who are also members of well-organized professions (Hall 1968); or because of the weaknesses of organizational control, as for example in implementation across geographic or cultural distances (Brytting 1986).

Retrieval of Experience

Even within a consistent and accepted set of routines, only part of an organization's memory is likely to be evoked at a particular time, or in a particular part of the organization. Some parts of organizational memory are more available for retrieval than others. Availability is associated with the frequency of use of a routine, the recency of its use, and its organizational proximity. Recently used and frequently used routines are more easily evoked than those that have been used infrequently. Thus, organizations have difficulty retrieving relatively old, unused knowledge or skills (Argote et al 1987). In cases where routines are nested within more general routines, the repetitive use of lower level routines tends to make them more accessible than the more general routine to which they are related (Merton 1940). The effects

of proximity stem from the ways the accumulation of history is linked to regularized responsibility. The routines that record lessons of experience are organized around organizational responsibilities and are retrieved more easily when actions are taken through regular channels than when they occur outside those channels (Olsen 1983). At the same time, organizational structures create advocates for routines. Policies are converted into responsibilities that encourage rule zealotry (Mazmanian & Nienaber 1979).

Availability is also partly a matter of the direct costs of finding and using what is stored in memory. Particularly where there are large numbers of routines bearing on relatively specific actions, modern information technology has reduced those costs and made the routinization of relatively complex organizational behavior economically feasible, for example in the preparation of reports or presentations, the scheduling of production or logistical support, the design of structures or engineering systems, or the analysis of financial statements (Smith & Green 1980). Such automation of the recovery of routines makes retrieval more reliable. Reliability is, however, a mixed blessing. It standardizes retrieval and thus typically underestimates the conflict of interest and ambiguity about preferences in an organization. Expert systems of the standard type have difficulty capturing the unpredictable richness, erratic redundancy, and casual validity checking of traditional retrieval procedures, and they reduce or eliminate the fortuitous experimentation of unreliable retrieval (Simon 1971, Wildavsky 1983). As a result, they are likely to make learning more difficult for the organization.

LEARNING FROM THE EXPERIENCE OF OTHERS

Organizations capture the experience of other organizations through the transfer of encoded experience in the form of technologies, codes, procedures, or similar routines (Dutton & Starbuck 1978). This diffusion of experience and routines from other organizations within a community of organizations complicates theories of routine-based learning. It suggests that understanding the relation between experiential learning and routines, strategies, or technologies in organizations will require attention to organizational networks (Håkansson 1987) as well as to the experience of the individual organization. At the same time, it makes the derivation of competitive strategies (e.g. pricing strategies) more complex than it would otherwise be (Hilke & Nelson 1987).

Mechanisms for Diffusion

The standard literature on the epidemiology of disease or information distinguishes three broad processes of diffusion. The first is diffusion involving a single source broadcasting a disease to a population of potential, but not necessarily equally vulnerable, victims. Organizational examples include

rules promulgated by governmental agencies, trade associations, professional associations, and unions (Scott 1985). The second process is diffusion involving the spread of a disease through contact between a member of the population who is infected and one who is not, sometimes mediated by a host carrier. Organizational examples include routines diffused by contacts among organizations, by consultants, and by the movement of personnel (Biggart 1977). The third process is two-stage diffusion involving the spread of a disease within a small group by contagion and then by broadcast from them to the remainder of a population. Organizational examples include routines communicated through formal and informal educational institutions, through experts, and through trade and popular publications (Heimer 1985a). In the organizational literature, these three processes have been labeled *coercive, mimetic,* and *normative* (DiMaggio & Powell 1983). All three are involved in a comprehensive system of information diffusion (Imai et al 1985).

Dynamics of Diffusion

The possibilities for learning from the experience of others, as well as some of the difficulties, can be illustrated by looking at the diffusion of innovations among organizations. We consider here only some issues that are particularly important for organizational learning. For more general reviews of the literature, see Rogers & Shoemaker (1971) and Kimberly (1981).

Although it is not easy to untangle the effects of imitation from other effects that lead to differences in the time of adoption, studies of the spread of new technologies among organizations seem to indicate that diffusion through imitation is less significant than is variation in the match between the technology and the organization (Mansfield 1968), especially as that match is discovered and molded through learning (Kay 1979). Imitation, on the other hand, has been credited with contributing substantially to diffusion of city manager plans among American cities (Knoke 1982) and multidivisional organizational structures among American firms (Fligstein 1985). Studies of the adoption of civil service reform by cities in the United States (Tolbert & Zucker 1983) and of high technology weaponry by air forces (Eyre et al 1987) both show patterns in which features of the match between the procedures and the adopting organizations are more significant for explaining early adoptions than they are for explaining later ones, which seem better interpreted as due to imitation. The latter result is also supported by a study of the adoption of accounting conventions by firms (Mezias 1987).

The underlying ideas in the literature on the sociology of institutionalization are less epidemiological than they are functional, but the diffusion of practices and forms is one of the central mechanisms considered (Zucker 1987). Pressure on organizations to demonstrate that they are acting on collectively valued purposes in collectively valued ways leads them to copy ideas and practices from each other. The particular professions, policies,

programs, laws, and public opinion that are created in the process of producing and marketing goods and services become powerful institutionalized myths that are adopted by organizations to legitimate themselves and ensure public support (Meyer & Rowan 1977, Zucker 1977). The process diffuses forms and procedures and thereby tends to diffuse organizational power structures as well (Fligstein 1987).

The dynamics of imitation depend not only on the advantages that come to an organization as it profits from the experience of others, but also on the gains or losses that accrue to those organizations from which the routines or beliefs are drawn (DiMaggio & Powell 1983). In many (but not all) situations involving considerations of technical efficiency, diffusion of experience has negative consequences for organizations that are copied. This situation is typified by the case of technical secrets, where sharing leads to loss of competitive position. In many (but not all) situations involving considerations of legitimacy, diffusion of experience has positive consequences for organizations that are copied. This situation is typified by the case of accounting practices, where sharing leads to greater legitimacy for all concerned.

The critical factor for the dynamics is less whether the functional impetus is a concern for efficiency or legitimacy than whether the feedback effects are positive or negative (Wiewel & Hunter 1985). Where concerns for technical efficiency are associated with positive effects of sharing, as for example in many symbiotic relations within an industry, the process will unfold in ways similar to the process of institutionalization. Where concerns for legitimacy are associated with negative effects of sharings as for example in cases of diffusion where mimicking by other organizations of lower status reduces the lead organization's status, the process will unfold in ways similar to the spread of secrets.

ECOLOGIES OF LEARNING

Organizations are collections of subunits learning in an environment that consists largely of other collections of learning subunits (Cangelosi & Dill 1965). The ecological structure is a complication in two senses. First, it complicates learning. Because of the simultaneously adapting behavior of other organizations, a routine may produce different outcomes at different times, or different routines may produce the same outcome at different times. Second, an ecology of learners complicates the systematic comprehension and modeling of learning processes. Environments change endogenously, and even relatively simple conceptions of learning become complex.

Learning in a World of Learners

Ecologies of learning include various types of interactions among learners, but the classical type is a collection of competitors. Competitors are linked

partly through the diffusion of experience, and understanding learning within competitive communities of organizations involves seeing how experience, particularly secrets, are shared (Sitkin 1986), and how organizational actors come to trust one another, or not (Zucker 1986). Competitors are also linked through the effects of their actions on each other. One organization's action is another organization's outcome. As a result, even if learning by an individual organization were entirely internal and direct, it could be comprehended only by specifying the competitive structure.

Suppose competitors learn how to allocate resources to alternative technologies (strategies, procedures) in a world in which the return received by each competitor from the several technologies is a joint consequence of the potentials of the technologies, the changing competences of the several competitors within the technologies, and the allocations of effort by the several competitors among the technologies (Khandwalla 1981). In a situation of this type, it has been shown that there are strong ecological effects (Herriott et al 1985). The learning outcomes depend on the number of competitors, the rates at which they learn from their own experience, the rates at which they adjust their targets, the extent to which they learn from the experience of others, and the differences in the potentials of the technologies. There is a tendency for organizations to specialize and for faster learners to specialize in inferior technologies.

Learning to Learn

Learning itself can be viewed as one of the technologies within which organizations develop competence through use and among which they choose on the basis of experience. The general (nonecological) expectation is that learning procedures will become common when they lead to favorable outcomes and that organizations will become effective at learning when they use learning routines frequently. The ecological question is whether there are properties of the relations among interacting organizations that lead some of them to learn to learn and others not to do so.

In competitive situations, small differences in competence at learning will tend to accumulate through the competency multiplier, driving slower learners to other procedures. If some organizations are powerful enough to create their own environments, weaker organizations will learn to adapt to the dominant ones, that is they will learn to learn (Heimer 1985b). By the same token, powerful organizations, by virtue of their ability to ignore competition, will be less inclined to learn from experience and less competent at doing so (Engwall 1976). The circumstances under which these learning disabilities produce a disadvantage, rather than an advantage, are more complicated to specify than might appear, but there is some chance that a powerful organization will become incapable of coping with an environment that cannot be arbitrarily enacted (Hannan & Freeman 1984).

LEARNING AS A FORM OF INTELLIGENCE

Organizational learning from experience is not only a useful perspective from which to describe organizational change; it is also an important instrument of organizational intelligence. The speculation that learning can improve the performance, and thus the intelligence, of organizations is confirmed by numerous studies of learning by doing, by case observations, and by theoretical analyses. Since we have defined learning as a process rather than as an outcome, the observation that learning is beneficial to organizations is not empty. It has become commonplace to emphasize learning in the design of organizations, to argue that some important improvements in organizational intelligence can be achieved by giving organizations capabilities to learn quickly and precisely (Starbuck & Dutton 1973, Duncan & Weiss 1979). As we have seen, however, the complications in using organizational learning as a form of intelligence are not trivial.

Nor are those problems due exclusively to avoidable individual and organizational inadequacies. There are structural difficulties in learning from experience. The past is not a perfect predictor of the future, and the experimental designs generated by ordinary life are far from ideal for causal inference (Brehmer 1980). Making organizational learning effective as a tool for comprehending history involves confronting several problems in the structure of organizational experience: (*a*) The paucity of experience problem: Learning from experience in organizations is compromised by the fact that nature provides inadequate experience relative to the complexities and instabilities of history, particularly when the environment is changing rapidly or involves many dangers or opportunities each of which is very unlikely. (*b*) The redundancy of experience problem: Ordinary learning tends to lead to stability in routines, to extinguish the experimentation that is required to make a learning process effective. (*c*) The complexity of experience problem: Organizational environments involve complicated causal systems, as well as interactions among learning organizations. The various parts of the ecology fit together to produce learning outcomes that are hard to interpret.

Improving the Structure of Experience

The problems of paucity, redundancy, and complexity in experience cannot be eliminated, but they can be ameliorated. One response to the paucity of experience is the augmentation of direct experience through the diffusion of routines. Diffusion increases the amount of experience from which an organization draws and reduces vulnerability to local optima. However, the sharing of experience through diffusion can lead to remarkably incomplete or flawed understandings. For example, if the experiences that are combined are not independent, the advantages of sharing are attenuated, and organizations are prone to exaggerate the experience base of the encoded information. Indeed,

part of what each organization learns from others is likely to be an echo of its own previous knowledge (Anderson 1848).

Patience is a virtue. There is considerable evidence that organizations often change through a sequence of small, frequent changes and inferences formed from experience with them (Zald 1970). 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 & 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 & Yao 1988).

The sample size problem is particularly acute in learning from low probability, high consequence events. Not only is the number of occurrences small, but the organizational, political, and legal significance of the events, if they occur, often muddies the making of inferences about them with conflict over formal responsibility, accountability, and liability. One strategy for moderating the effects of these problems is to supplement history by creating hypothetical histories of events that might have occurred (Tamuz 1987). Such histories draw on a richer, less politically polarized set of interpretations, but they introduce error inherent in their hypothetical nature.

Difficulties in overcoming the redundancy of experience and assuring adequate variety of experience is a familiar theme for students of organizational change (Tushman & Romanelli 1985). Organizational slack facilitates unintentional innovation (March 1981), and success provides self-confidence in managers that leads to risk-taking (March & Shapira 1987); but in most other ways success is the enemy of experimentation (Maidique & Zirger 1985). Thus, concern for increasing experimentation in organizations focuses attention on mechanisms that produce variations in the failure rate, preferably independent of the performance level. One mechanism is noise in the measurement of performance. Random error or confusion in performance measurement produces arbitrary experiences of failure without a change in (real) performance (Hedberg & Jönsson 1978). A second mechanism is aspiration level adjustment. An aspiration level that tracks past performance (but not too closely) produces a failure rate—thus a level of search and risk taking—that is relatively constant regardless of the absolute level of performance (March 1988).

A second source of experimentation in learning comes from imperfect routine-maintenance—failures of memory, socialization, or control. Incomplete socialization of new organizational members leads to experimentation, as do errors in execution of routines or failures of implementation (Pressman & Wildavsky 1973). Although it seems axiomatic that most new ideas are bad ones (Hall 1976), the ideology of management and managerial

experience combine to make managers a source of experimentation. Leaders are exhorted to introduce change; they are supposed to make a difference (MacCrimmon & Wehrung 1986). At the same time, individuals who have been successful in the past are systematically more likely to reach top level positions in organizations than are individuals who have not. Their experience gives them an exaggerated confidence in the chances of success from experimentation and risk taking (March & Shapira 1987).

Overcoming the worst effects of complexity in experience involves improving the experimental design of natural experience. In particular, it involves making large changes rather than small ones and avoiding multiple simultaneous changes (Miller & Friesen 1982, Lounamaa & March 1987). From this point of view, the standard version of incrementalism with its emphasis on frequent, multiple, small changes cannot be, in general, a good learning strategy, particularly since it also violates the patience imperative discussed above (Starbuck 1983). Nor, as we have suggested earlier, is it obvious that fast, precise learning is guaranteed to produce superior performance. Learning that is somewhat slow and somewhat imprecise often provides an advantage (Levinthal & March 1981, Herriott et al 1985).

The Intelligence of Learning

The concept of intelligence is ambiguous when action and learning occur simultaneously at several nested levels of a system (March 1987). For example, since experimentation often benefits those who copy successes more than it does the experimenting organization, managerial illusions of control, risk taking, and playful experimentation may be more intelligent from the point of view of a community of organizations than from the point of view of organizations that experiment. Although legal arrangements, such as patent laws, attempt to reserve certain benefits of experimentation to those organizations that incur the costs, these complications seem, in general, not to be resolved by explicit contracts but through sets of evolved practices that implicitly balance the concerns of the several levels (March 1981). The issues involved are closely related to similar issues that arise in variation and selection models (Holland 1975, Gould 1982).

Even within a single organization, there are severe limitations to organizational learning as an instrument of intelligence. Learning does not always lead to intelligent behavior. The same processes that yield experiential wisdom produce superstitious learning, competency traps, and erroneous inferences. Problems in learning from experience stem partly from inadequacies of human cognitive habits, partly from features of organization, partly from characteristics of the structure of experience. There are strategies for ameliorating some of those problems, but ordinary organizational practices do not always generate behavior that conforms to such strategies.

The pessimism of such a description must, however, be qualified by two caveats. First, there is adequate evidence that the lessons of history as encoded in routines are an important basis for the intelligence of organizations. Despite the problems, organizations learn. Second, learning needs to be compared with other serious alternatives, not with an ideal of perfection. Processes of choice, bargaining, and selection also make mistakes. If we calibrate the imperfections of learning by the imperfections of its competititors, it is possible to see a role for routine-based, history-dependent, target-oriented organizational learning. To be effective, however, the design of learning organizations must recognize the difficulties of the process and in particular the extent to which intelligence in learning is often frustrated, and the extent to which the comprehension of history may involve slow rather than fast adaptation, imprecise rather than precise responses to experience, and abrupt rather than incremental changes.

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Literature Cited

Anderson, H. C. 1848. Det er ganske vist. In *H. C. Andersens Eventyr*, ed. P. Høybe, pp. 72–75. Copenhagen: Forlaget Notabene

Argote, L., Beckman, S., Epple, D. 1987. The persistence and transfer of learning in industrial settings. Paper presented at the St. Louis meetings of the Institute of Management Sciences (TIMS) and the Operations Research Society of America (ORSA)

Argyris, C., Schön, D. 1978. *Organizational Learning*. Reading: MA: Addison-Wesley

Arthur, W. B. 1984. Competing technologies and economic prediction. *IIASA Options* 2:10–13

Asher, H. 1956. *Cost-Quantity Relationships in the Airframe Industry*. Santa Monica, CA: Rand

Astley, W. G. 1985. The two ecologies: population and community perspectives on organizational evolution. *Admin. Sci. Q.* 30:224–41

Barley, S. R. 1988. The social construction of a machine: ritual, superstition, magical thinking and other pragmatic responses to running a CT Scanner. In *Knowledge and Practice in Medicine: Social Cultural and Historical Approaches*, ed. M. Lock, D. Gordon. Hingham, MA: Reidel. In press

Becker, H. S. 1982. *Art Worlds*. Berkeley, CA: Univ. Calif. Press

Beyer, J. M. 1981. Ideologies, values, and decision making in organizations. See Nystrom & Starbuck 1981, 2:166–202

Biggart, N. W. 1977. The creative-destructive process of organizational change: the case of the post office. *Admin. Sci. Q.*, 22:410–26

Brehmer, B. 1980. In one word: not from experience. *Acta Psychol.* 45:223–41

Brown, R. H. 1978. Bureaucracy as praxis: toward a political phenomenology of formal organizations. *Admin. Sci. Q.* 23:365–82

Brunsson, N. 1985. *The Irrational Organization: Irrationality as a Basis for Organizational Action and Change*. Chichester, UK: Wiley

Brytting, T. 1986. The management of distance in antiguity. *Scand. J. Mgmt. Stud.* 3:139–55

Burchell, S., Colin, C., Hopwood, A. G. 1985. Accounting in its social context: towards a history of value added in the United Kingdom. *Account. Organ. Soc.*, 10:381–413

Burgelman, R. A. 1988. Strategy-making as a social learning process: the case of internal corporate venturing. *Interfaces* 18:In press

Cangelosi, V. E., Dill, W. R. 1965. Organizational learning: observations toward a theory. *Admin. Sci. Q.* 10:175–203

Carroll, G. R. 1984. Organizational ecology. *Ann. Rev. Sociol.* 10:71–93
Clark, B. R. 1972. The organizational saga in higher education. *Admin. Sci. Q.* 17:178–84
Cooper, A. C., Schendel, D. E. 1976. Strategic responses to technological threats. *Bus. Horizons* Feb: 19(1):61–63
Cyert, R. M., March, J. G. 1963. *A Behavioral Theory of the Firm.* Englewood Cliffs, NJ: Prentice-Hall
Daft, R. L., Lengel, R. H. 1984. Information richness: a new approach to managerial behavior and organization design. In *Research in Organizational Behavior,* ed. B. M. Staw, L. L. Cummings, 6:191–223. Greenwich, CT: JAI Press
Daft, R. L., Weick, K. E. 1984. Toward a model of organizations as interpretation systems. *Acad. Mgmt. Rev.* 9:284–95
Day, G. S., Montgomery, D. B. 1983. Diagnosing the experience curve, *J. Mark.* 47:44–58
DiMaggio, P. J., Powell, W. W. 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.* 48:147–60
Duncan, R., Weiss, A. 1979. Organizational learning: implications for organizational design. In *Research in Organizational Behavior,* ed. B. M. Staw, 1:75–123. Greenwich, CT: JAI Press
Dutton, J. M., Freedman, R. D. 1985. External environment and internal strategies: calculating, experimenting, and imitating in organizations. In *Advances in Strategic Management,* ed. R. B. Lamb 3:39–67. Greenwich, Conn: JAI
Dutton, J. M., Starbuck, W. H. 1978. Diffusion of an intellectual technology. In *Communication and Control in Society,* ed. K. Krippendorff, pp. 489–511. New York: Gordon & Breach
Dutton, J. M., Thomas, A. 1984. Treating progress functions as a managerial opportunity. *Acad. Mgmt. Rev.* 9:235–47
Dutton, J. M., Thomas, A. 1985. Relating technological change and learning by doing. In *Research on Technological Innovation, Management and Policy,* ed. R. S. Rosenbloom, 2:187–224. Greenwich, Conn: JAI
Dutton, J. M., Thomas, A., Butler, J. E. 1984. The history of progress functions as a managerial technology. *Bus. Hist. Rev.* 58:204–33
Einhorn, E. J., Hogarth, R. M. 1986. Judging probable cause. *Psychol. Bull.* 99:3–19
Engwall, L. 1976. Response time of organizations. *J. Mgmt. Stud.* 13:1–15
Eyre, D. P., Suchman, M. C., Alexander, V. D. 1987. The social construction of weapons procurement: proliferation as rational myth. Pap. pres. Ann. Meet. Am. Sociol. Assoc. Chicago
Fiol C. M., Lyles, M. A. 1985. Organizational learning. *Acad. Mgmt. Rev.* 10:803–13
Fischhoff, B. 1975. Hindsight or foresight: The effect of outcome knowledge on judgment under uncertainty. *J. Exper. Psychol.* 1:288–99
Fligstein, N. 1985. The spread of the multidivisional form among large firms, 1919–1979. *Am. Sociol. Rev.* 50:377–91
Fligstein, N. 1987. The intraorganizational power struggle: rise of finance personnel to top leadership in large corporations, 1919–1979. *Am. Sociol. Rev.* 52:44–58
Gould, S. J. 1982. Darwinism and the expansion of evolutionary theory. *Science* 216: 380–87
Hägg, I. 1979. Reviews of capital investments: empirical studies. *Finn. J. Bus. Econ.* 28:211–25
Häkansson, H. 1987. *Industrial Technological Development: A Network Approach.* London: Croom Helm
Hall, R. H. 1968. Professionalization and bureaucratization. *Am. Sociol. Rev.* 33:92–104
Hall, R. I. 1976. A system pathology of an organization: the rise and fall of the old Saturday Evening Post. *Admin. Sci. Q.* 21:185–211
Hannan, M. T., Freeman, J. 1977. The population ecology of organizations. *Am. J. Sociol.* 82:929–64
Hannan, M. T., Freeman, J. 1984. Structural inertia and organizational change. *Am. Sociol. Rev.* 49:149–64
Harrison, J. R., March, J. G. 1984. Decision making and post-decision surprises. *Admin. Sci. Q.* 29:26–42
Hastie, R., Park, B., Weber, R. 1984. Social memory. In *Handbook of Social Cognition,* ed. R. S. Wyer, T. K. Srull, 2:151–212. Hillsdale, NJ: Erlbaum
Hedberg, B. L. T. 1981. How organizations learn and unlearn. See Nystrom & Starbuck 1981, 1:3–27
Hedberg, B. L. T., Jönsson, S. 1978. Designing semi-confusing information systems for organizations in changing environments. *Account. Organ. Soc.* 3:47–64.
Heimer, C. A. 1985a. *Reactive Risk and Rational Action: Managing Moral Hazard in Insurance Contracts.* Berkeley, CA: Univ. Calif. Press
Heimer, C. A. 1985b. Allocating information costs in a negotiated information order: interorganizational constraints on decision making in Norwegian oil insurance. *Admin. Sci. Q.* 30:395–417
Herriott, S. R., Levinthal, D., March, J. G.

1985. Learning from experience in organizations. *Am. Econ. Rev.* 75:298–302
Hilke, J. C., Nelson, P. B. 1987. Caveat innovator: strategic and structural characteristics of new product innovations. *J. Econ. Behav. Organ.* 8:213–29
Holland, J. H. 1975. *Adaptation in Natural and Artificial Systems: An Introductory Analysis with Applications to Biology, Control and Artificial Intelligence*. Ann Arbor, MI: Univ. Mich. Press
Hollander, S. 1965. *The Sources of Increased Efficiency: A Study of DuPont Rayon Manufacturing Plants*. Cambridge, MA: MIT Press
House, R. J., Singh, J. V. 1987. Organizational behavior: some new directions for i/o psychology. *Ann. Rev. Psychol.* 38:669–718
Imai, K., Nonaka, I., Takeuchi, H. 1985. Managing the new product development process: how Japanese companies learn and unlearn. In *The Uneasy Alliance*, ed. K. Clark, R. Hayes, C. Lorentz, pp. 337–75. Boston: Harvard Grad. Sch. Bus.
Johnson, H. T., Kaplan, R. S. 1987. *Relevance Lost: The Rise and Fall of Management Accounting*. Boston, MA: Harvard Bus. Sch. Press
Johnson, M. K., Hasher, L. 1987. Human learning and memory. *Ann. Rev. Psychol.* 38:631–68
Kahneman, D., Slovic, P., Tversky, A., eds. 1982. *Judgment under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge Univ. Press
Kay, N. M. 1979. *The Innovating Firm: A Behavioral Theory of Corporate R&D*. New York: St. Martin's Press
Khandwalla, P. N. 1981. Properties of competing organizations. See Nystrom & Starbuck 1981, 1:409–32
Kimberly, J. R. 1981. Managerial innovation. See Nystrom & Starbuck 1981, 1:84–104
Knoke, D. 1982. The spread of municipal reform: temporal, spatial, and social dynamics. *Am. J. Sociol.* 87:1314–39
Krieger, S. 1979. *Hip Capitalism*. Beverly Hills, CA: Sage
Lant, T. K. 1987. *Goals, search, and risk taking in strategic decision making*. PhD thesis. Stanford Univ.
Levinthal, D. A., March, J. G. 1981. A model of adaptive organizational search. *J. Econ. Behav. Organ.* 2:307–33
Levinthal, D. A., Yao, D. A. 1988. The search for excellence: organizational inertia and adaptation. *Unpubl. ms.* Carnegie-Mellon Univ. In press
Levy, J. S. 1986. Organizational routines and the causes of war. *Int. Stud. Q.* 30:193–222
Lindblom, C. E. 1959. The "science" of muddling through. *Public Admin. Rev.*, 19:79–88
Lounamaa, P. H., March, J. G. 1987. Adaptive coordination of a learning team. *Mgmt. Sci.*, 33:107–23
Machina, M. J. 1987. Choice under uncertainty: problems solved and unsolved. *J. Econ. Perspect.* 1:121–54
MacCrimmon, K. R., Wehrung, D. A. 1986. *Taking Risks: The Management of Uncertainty*. New York: Free Press
MacRae, D. 1985. *Policy Indicators*. Chapel Hill, NC: Univ. North Carolina Press
Maidique, M. A., Zirger, B. J. 1985. The new product learning cycle. *Res. Policy* 14:299–313
Mansfield, E. 1968. *The Economics of Technological Change*. New York: Norton
March, J. G. 1981. Footnotes to organizational change. *Admin. Sci. Q.* 26:563–77
March, J. G. 1987. Ambiguity and accounting: the elusive link between information and decision making. *Account. Organ. Soc.* 12:153–68
March, J. G. 1988. Variable risk preferences and adaptive aspirations. *J. Econ. Behav. Organ.* 9:5–24
March, J. G., Olsen, J. P. 1975. The uncertainty of the past: organizational learning under ambiguity. *Eur. J. Polit. Res.* 3:147–71
March, J. G., Shapira, Z. 1987. Managerial perspectives on risk and risk taking. *Mgmt. Sci.* 33:1404–18
Martin, J., Siehl, C. 1983. Organizational culture and counterculture: an uneasy symbiosis. *Organ. Dynam.* Autumn:52–64
Martin, J., Sitkin, S. B., Boehm, M. 1985. Founders and the elusiveness of a culture legacy. In *Organizational Culture*, ed. P. J. Frost, L. F. Moore, M. R. Louis, C. C. Lundberg, J. Martin, pp. 99–124. Beverly Hills, CA: Sage
Mazmanian, D. A., Nienaber, J. 1979. *Can Organizations Change? Environmental Protection, Citizen Participation, and the Corps of Engineers*. Washington, DC: The Brookings Inst.
Merton, R. K. 1940. Bureaucratic structure and personality. *Soc. Forces* 18:560–68
Meyer, J. W., Rowan, B. 1977. Institutionalized organizations: formal structure as myth and ceremony. *Am. J. Sociol.* 83:340–63
Mezias, S. J. 1987. *Technical and Institutional Sources of Organizational Practices: The Case of a Financial Reporting Method*. PhD thesis. Stanford Univ.
Miller, D. T., Ross, M. 1975. Self-serving biases in the attribution of causality. *Psychol. Bull.* 82:213–25
Miller, D., Friesen, P. 1982. Structural change and performance: quantum vs.

piecemeal-incremental approaches. *Acad. Mgmt. J.* 25:867–92
Moore, M. H., Gates, M. J. 1986. *Inspector-General: Junkyard Dogs or Man's Best Friend?* New York: Russell Sage Found.
Muth, J. F. 1986. Search theory and the manufacturing progress function. *Mgmt. Sci.* 32:948–62
Nelson, R. R., Winter, S. G. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard Univ.
Neustadt, R. E., May, E. R. 1986. *Thinking in Time: The Uses of History for Decision Makers*. New York, NY: Free Press
Nystrom, N. C., Starbuck, W. H., eds. 1981. *Handbook of Organizational Design*. Oxford: Oxford Univ. Press
Nystrom, N. C., Starbuck, W. H. 1984. To avoid organizational crisis, unlearn. *Organ. Dynam.* Spring:53–65
Olsen, J. P. 1976. The process of interpreting organizational history. In *Ambiguity and Choice in Organizations,* ed. J. G. March, J. P. Olsen, pp. 338–50. Bergen, Norway: Universitetsforlaget
Olsen, J. P. 1983. *Organized Democracy*. Bergen, Norway: Universitetsforlaget
Ouchi, W. G. 1980. Markets, bureaucracies and clans. *Admin. Sci. Q.* 25:129–41
Pettigrew, A. M. 1985. *The Awakening Giant: Continuity and Change in Imperial Chemical Industries*. Oxford: Blackwell
Pfeffer, J. 1981. *Power in Organizations*. Marshfield, MA: Pitman
Powell, W. W. 1986. How the past informs the present: the uses and liabilities of organizational memory. Paper read at the Conference on Communication and Collective Memory, Annenberg School, University of Southern California.
Pressman, J. L., Wildavsky, A. B. 1973. *Implementation*. Berkeley: Univ. Calif. Press
Preston, L., Keachie, E. C. 1964. Cost functions and progress functions: an integration. *Am. Econ. Rev.* 54:100–7
Radner, R. 1975. A behavioral model of cost reduction. *Bell J. Econ.* 6:196–215
Rapping, L. 1965. Learning and World War II production functions. *Rev. Econ. Stat.* 47:81–86
Rogers, E. M., Shoemaker, F. F. 1971. *Communication of Innovations*. New York: Free Press
Rosenberg, N. 1982. *Inside the Black Box: Technology and Economics*. Cambridge: Cambridge Univ. Press
Ross, J., Staw, B. M. 1986. Expo 86: an escalation prototype. *Admin. Sci. Q.* 31:274–97
Scott, W. R. 1985. Conflicting levels of rationality: regulators, managers, and professionals in the medical care sector. *J. Health Admin. Educ.* 3:113–31
Scott, W. R. 1987. *Organizations: Rational, Natural, and Open Systems*. Englewood Cliffs: NJ: Prentice-Hall. 2nd ed.
Siegel, S. 1957. Level of aspiration and decision making. *Psychol. Rev.* 64:253–62
Simon, H. A. 1955. A behavioral model of rational choice. *Q. J. Econ.* 69:99–118
Simon, H. A. 1971. Designing organizations for an information rich world. In *Computers, Communications and the Public Interest,* ed. M. Greenberger, pp. 37–52. Baltimore, MD: Johns Hopkins Univ. Press
Sitkin, S. B. 1986. *Secrecy in Organizations: Determinants of Secrecy Behavior among Engineers in Three Silicon Valley Semiconductor Firms*. PhD thesis. Stanford Univ.
Slovic, P., Fischhoff, B., Lichtenstein, S. 1977. Behavioral decision theory. *Ann. Rev. Psychol.* 28:1–39
Smith, H. T., Green, T. R. G., eds. 1980. *Human Interaction with Computers*. New York: Academic
Sproull, L. S. 1981. Beliefs in organizations. See Nystrom & Starbuck 1981, 2:203–24
Sproull, L. S., Weiner, S., Wolf, D. 1978. *Organizing an Anarchy: Belief, Bureaucracy, and Politics in the National Institute of Education*. Chicago, IL: Univ. Chicago Press
Starbuck, W. H. 1983. Organizations as action generators. *Am. Sociol. Rev.* 48:91–102
Starbuck, W. H. 1976. Organizations and their environments. In *Handbook of Industrial and Organizational Psychology,* ed. M. D. Dunnette, pp. 1067–1123. Chicago: Rand McNally
Starbuck, W. H., Dutton, J. M. 1973. Designing adaptive organizations. *J. Bus. Policy* 3:21–28
Starbuck, W. H., Milliken, F. J. 1988. Executives' perceptual filters; what they notice and how they make sense. In *Executive Effect: Concepts and Methods for Studying Top Managers,* ed. D. Hambrick. Greenwich, Conn: JAI In press
Staw, B. M., Ross, J. 1978. Commitment to a policy decision: a multi-theoretical perspective. *Admin. Sci. Q.* 23:40–64
Steinbruner, J. D. 1974. *The Cybernetic Theory of Decision*. Princeton, NJ: Princeton Univ. Press
Stinchcombe, A. L. 1986. *Stratification and Organization*. Cambridge: Cambridge Univ. Press
Tamuz, M. 1987. The impact of computer surveillance on air safety reporting. *Columbia J. World Bus.* 22:69–77
Thompson, J. D. 1967. *Organizations in Action*. New York: McGraw-Hill
Tirole, J. 1986. Hierarchies and bureaucracies: on the role of collusion in organizations. *J. Law Econ. Organ.* 2:181–214

Tolbert, P. S., Zucker, L. G. 1983. Institutional sources of change in the formal structure of organizations: the diffusion of civil service reform, 1880–1935. *Admin. Sci. Q.* 28:22–39

Tushman, M. L., Romanelli, E. 1985. Organizational evolution: a metamorphosis model of convergence and reorientation. In *Research in Organizational Behavior,* ed. L. L. Cummings, B. M. Staw, 7:171–222. Greenwich, CT: JAI Press

Van Maanen, J. 1973. Observations on the making of policemen. *Hum. Organ.* 32:407–18

Weick, K. E. 1979. *The Social Psychology of Organizing*. Reading, MA: Addison-Wesley. 2nd ed.

Whetten, D. A. 1987. Organizational growth and decline processes. *Ann. Rev. Sociol.* 13:335–58

Wiewel, W., Hunter, A. 1985. The interorganizational network as a resource: a comparative case study on organizational genesis. *Admin. Sci. Q.* 30:482–96

Wildavsky, A. 1983. Information as an organizational problem. *J. Mgmt. Stud.* 20:29–40

Winter, S. G. 1986. The research program of the behavioral theory of the firm: orthodox critique and evolutionary perspective. In *Handbook of Behavioral Economics,* ed. B. Gilad, S. Kaish, 1:151–87. Greenwich, CT: JAI Press

Wright, T. P. 1936. Factors affecting the cost of airplanes. *J. Aeronautical Sci.* 3:122–28

Yelle, L. E. 1979. The learning curve: historical review and comprehensive survey. *Decision Sci.* 10:302–28

Zald, M. N. 1970. *Organizational Change: The Political Economy of the YMCA*. Chicago, IL: Univ. Chicago Press

Zucker, L. G. 1977. The role of institutionalization in cultural persistence. *Am. Sociol. Rev.* 42:726–43

Zucker, L. G. 1986. Production of trust: institutional sources of economic structure, 1840 to 1920. In *Research in Organizational Behavior,* ed. L. L. Cummings, B. M. Staw, 8:55–111. Greenwich, CT: JAI Press

Zucker, L. G. 1987. Institutional theories of organization. *Ann. Rev. Sociol.* 13:443–64