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THE MYOPIA OF LEARNING

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Organizational learning has many virtues, virtues which recent writings in strategic management have highlighted. Learning processes, however, are subject to some important limitations. As is well-known, learning has to cope with confusing experience and the complicated problem of balancing the competing goals of developing new knowledge (i.e., exploring) and exploiting current competencies in the face of dynamic tendencies to emphasize one or the other. We examine the ways organizations approach these problems through simplification and specialization and how those approaches contribute to three forms of learning myopia, the tendency to overlook distant times, distant places, and failures, and we identify some ways in which organizations sustain exploration in the face of a tendency to overinvest in exploitation. We conclude that the imperfections of learning are not so great as to require abandoning attempts to improve the learning capabilities of organizations, but that those imperfections suggest a certain conservatism in expectations.

In this paper, we examine processes of experiential learning as instruments of organizational intelligence. Learning processes are powerful aids to intelligence, and the modern vision of learning capabilities as a basis for strategic advantage is an important insight. However, there are limits to learning. Designing organizations to learn without attention to those limits is no more sensible than designing organizations to be rational without attention to the limits of rationality.

THE SEARCH FOR ORGANIZATIONAL INTELLIGENCE

Strategic management is built on a search for organizational intelligence, an attempt to make actions lead to outcomes that are consistent with

desires or conceptions of appropriateness. The objective is one that is both ambiguously defined and imperfectly achieved.

The vision of rationality

Earlier visions of strategic management focused on the use (or lack of use) of analytically rational decision procedures and pictured the task of intelligent management as that of facilitating rational action (Lorange, 1980). Organizational intelligence was associated with the specification of well-defined objectives and the pursuit of those objectives by gathering information to assess alternatives in terms of their expected future consequences and choosing actions expected to fulfill objectives. The structure of tasks, assignments of individuals to those tasks, incentives, and relationships were seen as dictated by requirements for gathering information relevant to making allocative decisions, assuring that the best possible future-oriented actions were chosen, and controlling their implementation.

Key words: Organizational learning, adaptation, inertia

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Strategies for exploiting comparative advantage and competitive opportunities were built on a conception of calculated rationality.

This vision of calculative rationality as the basis of strategic management continues to be the dominant vision, though it has been modified on the basis of various criticisms of its assumptions, particularly those associated with the availability of information, the information processing capabilities of organizations, and the preference axioms of rationality. Because strategic anticipatory rationality seems to demand both greater cognitive and calculative capabilities and more consistency and stability in preferences than can be reliably assumed, considerable effort has been directed to improving the informational and analytical basis for organizational action and to developing consistent, stable organizational objectives. Modern decision-oriented information systems and procedures for defining (or negotiating) goals reflect this spirit (Keen and Morton, 1978; Jones and MacLeod, 1986).

The discovery of learning

At the same time as ideas of strategic calculative rationality have been modified and refined, learning has been 'discovered' by the world of practice and the academic field of strategic management. As researchers have considered the stability of differences in firm performance in the face of changing business environments, many have come to view the ability to learn as an important, indeed in some accounts a unique, source of sustainable competitive advantage (Burgelman, 1990; Senge, 1990). This is reflected both in the attention to learning and learning organizations in management circles (Senge, 1990; Stalk, Evans, and Shulman, 1992) and in the exploration of learning models of adaptation by economists (Cross, 1983) and students of organizations (Argyris and Schön, 1978; Levitt and March, 1988).

Learning from experience

Organizations and the individuals in them often improve their performance over repetitions of the same task. Repetition-based improvements in manufacturing performance have been documented in some detail in numerous studies of learning curves (Yelle, 1979). The costs of

producing manufactured items decrease with the cumulative number of items produced. It is natural to attribute the improvements documented in studies of manufacturing to knowledge gained from experience. The lessons of experience are transferable from one operating unit to another (Argote, Beckman, and Epple, 1990). They may also spillover from one activity to another (Udayagiri and Balakrishnan, 1993).

Such experiential-based knowledge can be an important basis of competitive advantage for a firm, and for some students of organizations and strategy, learning has become a plausible mechanism substituting for, or augmenting, calculative rationality in the pursuit of intelligent organizational action. The (re)discovery of learning has been stimulated by the current interest among students of strategic management in organizational capabilities and knowledge (Prahalad and Hamel, 1990). Successful organizations are described as having capabilities for learning—for responding to experience by modifying their technologies, forms, and practices (Stalk *et al.*, 1992). Executives are enjoined to monitor their experience in order to learn from it and to organize to stimulate learning and the utilization of knowledge gained from the experience of others as well as their own (Senge, 1990). These enthusiasms supplement—and to some extent replace—earlier enthusiasms for long-term planning and rational calculation as bases for organizational prosperity and survival.

Confusions of experience

Studies of reductions in the cost of production associated with the number of units produced do not, in general, provide direct confirmation of the processes by which those improvements have occurred, nor do they demonstrate that experiential learning processes inexorably lead to optimal practices. The limitations of experience as an instrument of intelligence are not esoteric. They stem from relatively generic problems of adaptive intelligence.

Experience is often a poor teacher, being typically quite meager relative to the complex and changing nature of the world in which learning is taking place. Many of the same cognitive limits that constrain rationality also constrain learning. Learning from experience involves inferences from information. It involves

memory. It involves pooling personal experience with knowledge gained from the experiences of others. The difficulties in learning effectively in the face of confusing experience are legendary. Even highly capable individuals and organizations are confused by the difficulties of using small samples of ambiguous experience to interpret complex worlds (Brehmer, 1980; Fischhoff, 1980).

The cognitive and inferential limitations of individuals are accentuated by organizational limitations. The interpretations of history are political, reflecting efforts to assign and evade responsibility and to establish favorable historical stories (Sagan, 1993). Organizations record the lessons of histories in the modification of rules and the elaboration of stories, but neither is a perfect instrument. Problems of memory, conflict, turnover, and decentralization make it difficult to extract lessons from experience and to retain them (March, Sproull, and Tamuz, 1991).

Self-limiting properties of learning

Recent examinations of learning as an adaptive process have raised questions not only about the confusions of experience but also about the ways in which learning is self-limiting. The effectiveness of learning in the short-run and in the near neighborhood of current experience interferes with learning in the long run and at a distance. Knowledge and the development of capabilities improve immediate performance, but they often simultaneously reduce incentives for and competence with new technologies or paradigms. Learning has its own traps.

In the next three sections, we consider the major mechanisms organizations use to reduce experimental confusion, the problems of myopia they face, and the dynamic complications of balancing exploration and exploitation in learning.

TWO MECHANISMS OF LEARNING

Organizations use two major mechanisms to facilitate learning from experience. The first is *simplification*. Learning processes seek to simplify experience, to minimize interactions and restrict effects to the spatial and temporal neighborhood of actions. The second mechanism is *specialization*. Learning processes tend to focus attention and narrow competence. Neither simplification

nor specialization is unique to learning processes. They are, however, particularly salient to discussions of the design of learning organizations.

Simplification and the construction of buffers

Learning presumes interpretation of experience. Organizations code outcomes into successes and failures and develop ideas about causes for them. Experience is clouded by the interactive complexity of history, particularly by the way experience is shaped by many actors simultaneously learning. If one's own actions are embedded in an ecology of the actions of many others (who are also simultaneously learning and changing), it is not easy to understand what is going on. The relationship between the actions of individuals in the organization and overall organizational performance is confounded by simultaneous learning of other actors. Particularly in environments in which performance is a noisy reflection of organizational decisions, highly interactive learning is likely to be unrewarding. For example, while isolated subunits can often learn quite effectively (Cyert and March, 1992; Lave and March, 1993), simultaneous learning by several interacting subunits in a noisy environment can be quite difficult (Lounamaa and March, 1987).

Organizations that want to disentangle the interactions introduced by multiple simultaneous learners have two general options: They can seek to generate enough experience so that they can fit relatively complicated models to the data. In practice, this is often not feasible. Alternatively, organizations can seek to control the effects of interactions by preventing multiple simultaneous adjustments. One means of increasing the effectiveness of learning is to simplify natural experience by inhibiting learning in one part of an organization in order to make learning more effective in another part (Lounamaa and March, 1987). Organizations seek to transform confusing, interactive environments into less confusing, less interactive ones by decomposing domains and treating the resulting subdomains as autonomous. They create buffers. They enact environments.

Decomposition and organizational structures

Departmentalization is, perhaps, the most basic mechanism to mitigate interaction effects in

learning within a complex organization. Although the transformation from functional to product organizations has usually been justified as a means to enhance control and coordination (Chandler, 1962), it also is a way of segregating experience. Less prominent in the normative literature on strategy and organizations, but prominent in more descriptive accounts (Cyert and March, 1992) is the sequential allocation of attention to divergent goals. While the sequential allocation of attention is generally viewed as an outcome of goal conflict and bounded rationality, it also results in a simplification of experiments in organizational change.

The conception of buffers as enhancing organizational effectiveness has a long tradition in the organizations literature (Thompson, 1967), and resource or other buffers between units can achieve substantial simplifications of the learning environment. Buffers between units (departmentalization) and between goals (sequential attention) allow local consequences to be examined. Marketing departments experiment with alternative marketing strategies and production departments experiment with alternative production strategies, each evaluated in such a way that their effects on each other are ignored. Depending on an organization's structure, global problems of poor performance are viewed as local problems of cost reduction or as local problems of revenue enhancement.

It is noteworthy, however, that many contemporary academics and practitioners advocate the tight coupling of organizations (Bower and Hout, 1988). Perhaps the most prominent application of ideas of tight coupling is the notion of lean production systems and just-in-time inventory systems. The ideas extend beyond manufacturing, however. In some cases, the idea of making organizations tightly coupled is tied to ideas about the importance of linkages to customers and has produced popular organizational slogans about the desirability of being 'customer driven.' In other cases, the ideas have been extended to linkages within the organization (Schonberger, 1990).

Advocates of these various mechanisms of tight coupling suggest that an important virtue of such structures is that they enhance learning. Learning is enhanced because the problems that arise through ongoing operations in one part of the system become observable, and hence an

occasion for learning, in other elements of the system. Customer complaints are not merely absorbed by boundary spanning personnel but become more broadly known. Problems in production are not masked by a buffer inventory of partially assembled units or by postproduction inspection and repair.

The apparent discrepancy between the two perspectives on buffers can, in part, be resolved by considering the simultaneous difficulties of oversight produced by the way buffers conceal signals of problems and difficulties of misinterpretation of signals produced by trying to understand complex, interactive systems. The former difficulties suggest tight coupling in order to facilitate detection of signals; the latter difficulties suggest loose coupling in order to facilitate their interpretation. The basic argument of those who advocate tight coupling is that many organizations have gone too far in attempting to segregate the problems they face. The arguments are twofold. On the one hand, they are assertions that modern markets and technologies link things together more than earlier ones did. On the other hand, they are also assertions that modern analytical and coordination techniques—perhaps due to new developments in information technology—reduce the costs of centralized problem solving.

Tightly coupled systems are relatively good for system-wide error detection, but they are relatively poor for error diagnostics. Loosely coupled systems make diagnostics easier (assuming that the system is, in fact, decomposable) but localize error detection, thereby making more general awareness of problems difficult. The appropriate balance between investments in error detection and in diagnostics presumably depends on the frequency of errors and the difficulty of diagnosis.

Decomposition and enactment

The conditions under which the buffers of departmentalization or sequential attention lead to effective local learning are usually described in terms of the extent to which the problems that are faced are decomposable, so that relatively few interactions occur across departmental boundaries or across goals (Gulick and Urwick, 1937). Decomposability is usually treated as an inherent property of a problem. Insofar as decomposability

is invariant, simplifications produced by departmentalization or sequential attention will work (or not work) depending on the nature of the problem. Part of the appeal of the so-called horizontal organization (Ostroff and Smith, 1992) is that it forces formerly buffered units of the organization to learn more about end customer preferences. The argument is that standard organizational structures make an inappropriate decomposition of the problems of the organization.

Decomposability may, however, be imposed rather than given. The problems an organization faces are not only exogenous technical ones but also social and political problems whose existence and character are affected by the character of organizational attention structures. Organizations enact their own environments. By treating problems as separable, they make them separable (Weick, 1979). Problems that are not seen do not exist. Or at least, their manifestations are delayed, and being delayed are likely to be transformed over time—possibly becoming more severe and unavoidable but also possibly becoming irrelevant or minor.

Many forms of enactment involve the realization and elaboration of an imposed social structure. The drawing of national boundaries or the departmentalization of organizations or the definition of markets creates self-confirming political, economic, technological, and social processes that convert relatively arbitrary units into real ones (March and Olsen, 1989). Consider, for example, the construction of attention barriers between subunits of an organization. Restricting the flow of information restricts knowledge of opportunities and activities. The reduction in knowledge leads to a reduction in salience. Ideas change about what is relevant and what is not. Solutions to problems are localized to the domains of the problems as defined organizationally. A classic form of the enactment of an environment is the development of mental models of the world, such as those institutionalized into scientific disciplines, each of which creates a relatively autonomous system. Similarly, as organizations find or construct 'niches' for themselves, they simultaneously construct private comprehensible worlds.

Organizations and the individuals in them are notoriously reluctant to give up such mental models (Kuhn, 1970). Rigidity results not only

from the institutionalization of specialised capabilities, but also from the institutionalization of an organization's political structure (Boeker, 1989). Success tends to launch managers associated with it into positions of power within the organization. Organizational power associated with past successes tends to linger.

Specialization and the principle of learning substitution

A learning system can adapt through several different mechanisms at several different points with approximately the same overall effect. Consequently, different learning locales or mechanisms are substitutes for each other. Assuming that the system avoids becoming unstable with simultaneous, interactive adaptations that confound all learning, the success of adaptation by one part of a system has two major effects: On the one hand, it relieves pressure for adaptation in another part. Insofar as equivalent effects can be achieved in several different ways, adjustment in one way tends to inhibit adjustment in another. At the same time, the adapting part of the system develops greater and greater adaptive competence relative to the part of the system that is not used. The two effects combine to produce specialization of learning competence.

Multiple actors: Fast learners and slow learners

Rapid adaptation by one party reduces the need for, and likelihood of, adaptation by another. The proposition is well-known in theories of bargaining, where conscious efforts are made to force opponents to adjust first (Schelling, 1960). Thus, a hard bargainer might introduce various devices to demonstrate the impossibility of changing positions, for example irrevocable decisions. In the world of mutual adaptation, strategic calculation is less central, but the proposition remains the same. In this case, the fast learning collaborator moves more than the slower partner (Lave and March, 1993).

The classic situation is one involving two drivers on a collision course. The first driver to understand the situation and react to it, relieves the other driver of the necessity of response. (In this case, of course, there is the possibility that a sequence of independent adaptations will not avoid a collision.) Similarly, parents who are

particularly fast in adapting to their children's needs reduce the pressure on the latter to be adaptive, resulting in a lack of socialization (manners) in children of highly adaptive parents. Or, political/legal systems that meet special or changing circumstances through adaptation by law enforcement agencies or by courts reduce the pressure on legislatures for changes in the statutes.

Multiple mechanisms: Targets, search, and slack

In bounded rationality search models, an organization is seen as responding to success or failure by varying the intensity of search, the level of organizational slack, and the target (aspiration level) for performance (Cyert and March, 1992). Success decreases search and increases slack and targets, while failure increases search and decreases slack and targets. Changes in search, slack, and targets function effectively as substitutes for each other. Adjustments in search substitute for adjustments in slack or aspirations, and vice versa. The different responses have equivalent effects from the point of view of restoring the aspiration/performance equilibrium, but they are not necessarily equivalent from the point of view of the organization and its learning.

In particular, there may be substantial differences in the long run between a system that adjusts aspirations slowly and slack rapidly and a system that adjusts aspirations rapidly and slack slowly. For example, the standard pygmalion story is one in which aspiration adjustments to unsatisfactory performance are slowed by means of rosy interpretations of that performance. The classic pygmalion complication is that rosy interpretations of performance inhibit a downward adjustment of aspirations, but they also inhibit reduction of slack and an increase in search (by underestimating the discrepancy between aspirations and performance).

Preferences also adapt in response to experience (March, 1988). Tastes for opera, ballet, and baseball are developed at the same times as competencies at those activities, and they are considerably affected by those competencies. Similarly, preferences for particular technologies develop in tandem with competencies at them. Since propensities to reevaluate the wisdom of engaging in particular activities are reduced by gains in competence at them, preference change

is an adaptive substitute for search or change in an activity.

Multiple responses: Exit, voice, and loyalty

The substitution principle has been used by Hirschman (1970) to account for some features of the development of rail transport in Nigeria, public school systems, and other systems that have dissatisfied participants. In Hirschman's framework, participants who experience a decline in quality of organizational services or products have two possible responses: The first alternative is to exit from the unsatisfactory relationship and seek another. The second alternative is to try to fix the existing relationship. The two are substitutes in the adaptive story of correcting declines in quality. From the vantage point of the dissatisfied participant, either of the alternatives is satisfactory in the sense that each has a reasonable prospect of removing the difficulty. Exit can substitute for voice, and vice versa.

From the point of view of the organization, however, the two alternative responses have quite different implications. If dissatisfied participants exit, they abandon the organization to less demanding participants, thus condemning it to a gradual degradation of capabilities. On the other hand, if dissatisfied participants exercise voice, they encourage the organization to improve quality. The organizational problem is to slow the exit of quality-conscious participants long enough to use their influence in improvement. One solution is found through the encouragement of loyalty, a form of friction on exit. The Hirschman loyalty mechanism can be seen as a way of slowing search and adjustment of aspiration levels in order to increase pressure on slack.

Multiple, nested options

Learning experience is nested. That is, learning occurs at several different but interrelated levels at the same time. An organization simultaneously learns *which* strategy to follow and *how* to operate within various alternative strategies (Herriott, Levinthal, and March, 1985). An individual simultaneously learns *whether* to think like an economist and *how* to think like an economist. An army learns *which* technology to use and *how* to use several alternative technologies. A business firm

learns *which* market to enter and *how* to function effectively in several alternative markets.

When learning is nested, learning at one level is effectively a substitute for learning at another. Refining an existing technology substitutes for recognizing a better one, and vice versa. Strengthening abilities within an existing paradigm substitutes for finding a new one that is better, and vice versa. Learning the nuances of an existing relationship substitutes for finding an alternative that is better, and vice versa.

The same thing happens within an organizational structure. Fast adaptation at one level in an organization leads to slow adaptation at other levels. Insofar as operating levels in an organization make adjustments in implementing policies as conditions change, the pressure for changes in policies is relieved. The operating managers of a firm in a changing competitive environment may adjust by discovering new markets for the firm's existing products. For instance, a defense manufacturer could respond to the decline in the U.S. military budget by pursuing foreign military markets for its wares.

Such adaptation, however, masks a higher level problem that the firm faces. Learning at the operating level of an organization substitutes for learning at higher levels. Insofar as customers adapt to the inadequacies of the products they use, manufacturers are less likely to do so. Insofar as subordinates respond to individual customer complaints, bosses are less pressed to do so. Lower-level adaptation is a sensible activity that tends to enhance an organization's position in its present environment. In the long run, however, such first-order learning can not substitute for second-order learning of new routines and strategies.

PROBLEMS OF MYOPIA

By simplifying experience and specializing adaptive responses, learning improves organizational performance, on average. However, the same mechanisms of learning that lead to the improvements also lead to limits to those improvements. In particular, we will note three forms of learning myopia: The first form of myopia is the tendency to ignore the long run. The short run is privileged by organizational learning. As a result, long run survival is sometimes endangered. The second

form of myopia is the tendency to ignore the larger picture. The near neighborhood is privileged by organizational learning. As a result, survival of more encompassing systems is sometimes endangered. The third form of myopia is the tendency to overlook failures. The lessons gained from success are privileged by organizational learning. As a result, the risks of failure are likely to be underestimated.

Overlooking distant times

There is no guarantee that short-run and long-run survival are consistent. It is easy to imagine situations in which the only strategies that permit survival in the short run assure failure in the long run and vice versa. Thus, it is fairly easy to make an argument that any consideration of the future must accept survival in the short run as a constraint. Simplification and specialization, however, seem exceptionally myopic with respect to the future. We can illustrate this by looking at the erosion of enactment with time. at the second order effects of learning substitution, and at some problems associated with knowledge inventories.

Erosion of enactment

Learning processes tend to enact environments that are sufficiently simple to permit inferences and incremental gains. There is, however, a limit to enactment. The classic tension between social construction of reality and the interventions of other reality processes (for example, of nature) is well-known. Learning creates a simplified world and specializes an organization to it. Such models are more likely to capture the central elements of past environments than the contingencies of current circumstances. Only the most enthusiastic observers of enactment deny that the world of nature constrains social enactment and sometimes forces reconsideration. Inexorably, at some point a mental model becomes unsustainable, and the organization's competencies become irrelevant. The process is as familiar to modern firms as it was to ancient systems of magic, religion, warfare, and trade.

Second-order effects of specialization

Substitutions of learning in one part of an organization for learning in another part are

normally sensible forms of specialized adaptation. They do, however, produce some dysfunctional second-order effects in the form of disparities in the development of adaptive capabilities. These effects typically take longer than do the immediate effects of local learning, involving as they do the development or decay of skills, procedures, and technologies of learning. A strategic problem is created by the fact that the learning that yields a comparative advantage in one domain is likely to be rewarding in the short run, but it leads to a longer-run potential decay of adaptive capability in other domains.

Traps of distinctive competence

An organization develops better skills in some parts of the organization, in some markets, in some technologies, and in some strategies than in others. The mechanism is one of mutual positive feedback between experience and competence. Organizations engage in activities at which they are more competent with greater frequency than they engage in activities at which they are less competent. The differences in the frequency with which different activities are pursued translate into differences in the amount of experience at the various potential activities, which in turn translate into differences in competence. These distinctive competencies invite utilization, which furthers their additional development. The self-reinforcing nature of learning makes it attractive for an individual or organization to sustain current focus. The result is that distinctive competence is accentuated, and organizations become specialized to niches in which their competencies yield immediate advantage.

Learners become increasingly removed from other bases of experience and knowledge and more vulnerable to change in their environments (David, 1985). Since the degree to which firms or individuals learn about alternative opportunities is a function of their level of involvement in them (Cohen and Levinthal, forthcoming), knowledge about and use of old competencies inhibit efforts to change capabilities. Abernathy and Wayne (1974) provide a classic illustration of this pathology when they describe Ford's pursuit of efficient production of the Model T. While the company was able to drive down the cost of the Model T, the transition to the Model A was

extraordinarily difficult and required shutting down the manufacturing facility for a considerable period of time.

Traps of power

Organizational power is a short-run asset but potentially a long-run liability. Power allows an organization to change its environments rather than adapt to them. Thus, firms with strong market positions impose their policies, products, and strategies on others, rather than learn to adapt to an exogenous environment. This capability to define an environment—such as a firm's capability to set industry standards—provides an advantage to the organization since it can organize around a specific plan without concern about contingencies. This advantage is exploited and improved upon by refining the skills of power.

In the long run, however, the use of power to impose environments is likely to result in atrophy of capabilities to respond to change. An organization becomes skilled at influencing its environment, but not at responding to the environment (Deutsch, 1966: 111). Should its ability to influence the environment be overwhelmed by economic, political, or demographic forces beyond its control, the underdevelopment of adaptive skills will be exposed, and there may not be enough time to overcome the resulting disadvantage.

Knowledge inventories and the problem of timing

The complications in balancing the long- and short run are also illustrated by the management of knowledge inventories. Organizations sometimes act by solving problems after they arrive. They discover problems, diagnose their causes, experiment with solutions to them, and then implement solutions that appear likely to yield favorable outcomes. Such a procedure is implied in many theories of decision making and by the design of many decision support systems. Often, however, organizational action is better seen as a programmed exercise of prior capabilities (Starbuck, 1983), or as the result of monitoring environments and drawing appropriate responses from a prior repertoire (March and Simon, 1993).

The surveillance/response mode is particularly

likely when response times are short. The time between the anticipation of a problem and its arrival may not be adequate for an organization to identify and develop the knowledge, or accumulate the experience, required to respond effectively. As Dierickx and Cool (1989) suggest, there are time compression diseconomies in building organizational capabilities. As a result, organizations build inventories of competencies (Feldman, 1989). The inventories are represented by storehouses of information and experience both within the organization and outside it. Organizations develop contingency plans. They stockpile knowledge about products, technologies, markets, and social and political contexts. They develop networks of contacts with consultants and colleagues.

In a world in which there are only a few possible situations and the appropriate responses are stable, maintaining appropriate knowledge inventories is relatively uncomplicated. Normally, those inventories are represented by a small number of specialized competencies maintained by the individuals and groups that make up the organization. Where situations or proper responses are numerous and shifting, it is harder to specify and realize optimal inventories of knowledge. By the time knowledge is needed, it is too late to gain it; before knowledge is needed, it is hard to specify precisely what knowledge might be required or useful. It is necessary to create inventories of competencies that might be used later without knowing precisely what future demands will be.

Determining the variety and depth of knowledge to be added to the inventory is filled with potential pitfalls. Knowledge that has clear, immediate uses is specialized to current technologies and markets. It is easily specified and has relatively early and local returns. Broader or deeper knowledge is less likely to have immediate pay-off but results in a greater ability to adapt to changes. Moreover, knowledge facilitates the use of other knowledge. Organizations that have some competence in an emerging technological domain are better able to assess the potential importance of that domain and to evaluate possible investments in new knowledge in that domain (Cohen and Levinthal, 1990 and forthcoming).

Overlooking distant places

As has been observed often in the study of the evolution of nested systems, it is relatively unusual for a strategy that maximizes the prospects for survival of the components of a system to be the same as a strategy that maximizes the prospects for the survival of the system as a whole (March, forthcoming 1994). Strategies of survival for organizations may be optimal neither for survival of the economies or social systems of which they are a part, nor for the individuals and groups that form the organization.

Selection among learners

As we have argued earlier, learning gives advantage to results in the spatial neighborhood of current action. Organizations that learn effectively become well-adapted to their environments, even as their environments become well-adapted to them. When the world changes exogenously, as inevitably it does, the matches between organizations well-adapted to their previous environments and the new environments are at risk. Existing organizations are likely to die and be replaced by new organizations which will, in turn, become specialized to the new environment.

This threat to organizational survival is substantial, but the resulting cycle of specialization and replacement may well be an efficient system for the system as a whole, combining as it does the advantages of learning at the organization level and the advantages of selection at the system level. Thus, the 'self-destructive' properties of learning are properties that make the replacement of obsolescent organizations easier. Rigidities in one individual or organization serve to exploit current knowledge and simultaneously make old markets vulnerable to new entities with new capabilities (Hannan and Freeman, 1984). Systematic advantages stemming from component vulnerability have, of course, long been favorite topics of evolutionary theorists, and it should be no surprise that they arise here.

Learning is, however, not entirely benign in its consequences for systems of organizations. The fruits of successful exploration, whether new technologies, product ideas, or modes of management, tend to diffuse over populations of organizations. They are public goods. In contrast, the risks and costs of exploration are private

goods; they tend to be borne by organizations carrying out such initiatives. The result is that the best strategy for any individual organization is often to emphasize the exploitation of successful explorations of others. Such a strategy, if followed by all, produces no innovations to imitate and a downward spiral of refining existing technologies and strategies. The system as a whole underinvests in exploration.

Knowledge diffusion

Not only do the returns to refinement and imitation depend on the degree to which others engage in exploration, so also do the returns to knowledge. Cohen and Levinthal (1989, 1990) make this argument in the context of research activities in business firms. Research performs the dual role of both generating new knowledge and enhancing a firm's ability to absorb new knowledge generated by others. With respect to this latter incentive to invest in research, the returns to research activity depend on the richness of the pool of external knowledge and the research activity of other firms. As a result, there may be multiple equilibria. If others engage in a high level of exploration activity, the pool of new knowledge into which an organization taps will be quite rich. As a result, it is attractive for the organization to invest at high levels as well. Alternatively, there may be low-level equilibria in which the pool of new knowledge is sufficiently modest so that individual organizations are not motivated to invest.

Such arguments suggest that, at the population level, there are increasing returns to investing in learning. A more knowledge-intensive environment tends to beget more investment in knowledge development. Similar arguments have appeared in recent years in the literature on economic development (Romer, 1986; Lucas, 1988). A puzzle for development economists has been why, with capital mobility, rates of productivity have not converged across countries. The answer that Romer (1986) and others provide is that the return to investment is a function of the existing infrastructure and human capital within a country.

Analogous arguments can be made at the organization level. The returns to knowledge to a particular actor or subunit will depend on the level of knowledge developed by others in the

organization. As a result, organizations may find themselves in self-reinforcing spirals of knowledge-generating activity leading to high levels of organizational renewal and growth. Alternatively, the self-reinforcing cycle can be a downward spiral in which individuals and subunits within the organization find the enhanced learning capability that results from knowledge of lesser and less value, leading to a reduction in their own knowledge-seeking activity, which in turn contributes toward a reduction in knowledge throughout the organization.

Overlooking failures

Learning is likely to be misleading if the experiential record on which it draws is a biased representation of past reality, and thus of future likelihoods. Organizational learning produces such a biased history. Learning generates successes rather than failures. In every domain of learning, the likelihood of success tends to increase with competence (even allowing for aspiration level adjustments). As learners settle into those domains in which they have competence and accumulate experience in them, they experience fewer and fewer failures. Insofar as they generalize that experience to other domains, they are likely to exaggerate considerably the likelihood of success.

As successes are translated into knowledge and knowledge into successes, not only do capabilities increase but also self-assurance. Organizations and the individuals in them become more confident that they have the skills to deal with problems that lie within their domains. Confidence in control over outcomes leads to learning from expectations of consequences before the consequences are observed, and it leads to reinterpretation of results to make them more favorable (Björkman, 1989; March *et al.*, 1991). In these ways, confidence finds confirmation in its own imagination. Since lack of confidence is similarly self-confirming for unsuccessful individuals, learning is less self-correcting than might be expected. Confidence grows slowly in the early stages of refining competence, when there are relatively frequent failures. Confidence grows rapidly as learning produces increasing numbers of successes.

Confidence is likely to become excessive when the experiential record of successes is a poor

predictor of future success. Consider, for example, using experiential learning to learn how to avoid or produce an extremely rare event—for example, a major nuclear disaster or a major scientific discovery. Experience rarely generates a rare event. As a result, most people involved in nuclear safety are likely to come to believe they are more capable of producing a safe environment than they actually are, and most people involved in scientific discovery are likely to come to believe they are less likely to produce a major scientific discovery than they actually are. Experience probably makes nuclear safety engineers over-confident and scientific researchers under-confident.

Research on individual attributions of causality to events indicates that individuals are more likely to attribute their successes to ability and their failures to luck than they are to attribute their successes to luck and their failures to ability (Miller and Ross, 1975). Biases in the perception of the relative contributions of ability and luck to outcomes translate into biases in the estimation of risk. Any inclination to over attribute outcomes to luck will be associated with overestimating risk, thus with decreasing risk taking. Similarly, any inclination to overattribute outcomes to ability will be associated with underestimating risk, thus with increasing risk taking. As a result, persistent failure leads to a tendency to overestimate the risks of actions, and persistent success leads to a tendency to underestimate those risks. Successful people have confidence in their ability to beat the apparent odds. They tend to underestimate the risks of their actions and overestimate their expected returns (March and Shapira, 1987; Kahneman and Lovalló, 1993). Since organizations promote successful people to positions of power and authority, rather than unsuccessful ones, it is the biases of success that are particularly relevant to decision making.

THE EXPLOITATION/EXPLORATION BALANCE

The elements of myopia detailed above are embedded in a broader problem for adaptive intelligence. Organizations divide attention and other resources between two broad kinds of activities (March, 1991). They engage in explo-

ration – the pursuit of new knowledge, of things that might come to be known. And they engage in exploration – the use and development of things already known. An organization that engages exclusively in exploration will ordinarily suffer from the fact that it never gains the returns of its knowledge. An organization that engages exclusively in exploitation will ordinarily suffer from obsolescence. The basic problem confronting an organization is to engage in sufficient exploitation to ensure its current viability and, at the same time, to devote enough energy to exploration to ensure its future viability. Survival requires a balance, and the precise mix of exploitation and exploration that is optimal is hard to specify.

Problems in Maintaining a Balance

Maintaining a balance between exploitation and exploration is complicated not only by the difficulty of determining what the appropriate balance should be, but also by several ways in which learning itself contributes to imbalances. Learning leads organizations into dynamics of accelerating exploitation or exploration, and learning makes negative as well as positive contributions to competitive position.

The traps of learning

Organizations become trapped in one or more of several dynamics of learning that self-destructively lead to excessive exploration or excessive exploitation. These dynamic distortions of the exploitation/exploration balance are not perverse. They stem from the same processes of adaptation that lead to effective matching of organizational behavior with environmental conditions (Hedberg, Nystrom and Starbuck, 1976). They are processes that involve short-term positive feedback on either exploration or exploitation and thus upset a balanced attention to both.

The failure trap

Sometimes exploration drives out exploitation. Organizations are turned into frenzies of experimentation, change, and innovation by a dynamic of failure. Failure leads to search and change which leads to failure which leads to

more search, and so on. New ideas and technologies fail and are replaced by other new ideas and technologies, which fail in turn. This pathology is driven by three pervasive features of organizational life:

1. Most new ideas are bad ones, so most innovations are unrewarding.
2. The return from any particular innovation, technology, or reform is partly a function of an organization's experience with the new idea. Even successful innovations, when first introduced, are likely to perform poorly until experience has been accumulated in using them.
3. Aspirations adjust downward more slowly than they adjust upward and exhibit a consistent optimistic bias (Lant, 1992).

These three features can trap an organization in an endless cycle of failure and unrewarding change. The cycle of exploration and the failure trap can be broken by the introduction of an exceptionally good alternative or the relatively rapid downward adjustment of aspirations, as might occur in a situation in which all organizations experience similar histories of failure.

The success trap

Sometimes exploitation drives out exploration. The returns to exploitation are ordinarily more certain, closer in time, and closer in space than are the returns to exploration (March, 1991). Exploratory experiments with new procedures or forms are likely to lead to poorer results in the short run, and the returns to exploration are likely to be greater for the organization, or a population of organizations, than for an individual.

Particularly with rapid rates of turnover of decision makers, the uncertain and distant returns associated with exploration are likely to have a high discount rate associated with them. Furthermore, past exploitation in a given domain makes future exploitation in the same domain even more efficient. As a result, organizations discover the short-term virtue of local refinement and the folly of exploration (Levinthal and March, 1981). As they develop greater and greater competence at a particular activity, they engage in that activity more, thus further increasing competence and the opportunity cost of exploration. This competency trap is a

standard, potentially self-destructive product of learning. The trap can be broken by rapid upward adjustment of aspirations or by false feedback as to the high value of exploration, but it forms a powerful consequence of learning processes.

Learning and competitive advantage

There are two characteristic features of learning that are important to competitive advantage. The first is that learning generally increases average performance. More experienced and more extensively trained individuals or groups will generally do better than less experienced or less trained ones. The second feature of learning is that it generally increases reliability. More experienced and more extensively trained individuals and groups produce fewer surprises. Moreover, organizations accumulate experience across individuals. They use rules, procedures, and standard practices to ensure that the experiences of earlier individuals are transferred to newer members of the organization. This process of routinization is a powerful factor in converting collective experience into improved average performance. It is also a powerful influence on reliability and reduces the average amount of deviation from normative behavior as an individual or organization ages. Learning reduces variability.

Competitive advantage is clearly helped by the improved average performance that learning ordinarily offers. Indeed, this feature of learning makes it a prime contributor to competitive advantage. Improved reliability, on the other hand, is a mixed blessing from the point of view of competitive advantage. By increasing the reliability of individuals and organizations, learning tends to reduce exploratory deviation. When we ask whether individuals and organizations that learn will be selected by a competitive environment, we find that the answer is complicated. Competition can make reliability (and therefore learning) a disadvantage.

Consider the following simple model (March, 1991): Assume that survival is based on comparative performance within a group of competitors. Each single performance is a draw from a performance distribution specific to a particular individual or organization. The mean of the distribution reflects the individual's or organization's ability level and the variance reflects

the individual's or organization's reliability. If position is based on a sample of performances that is very large, the relative positions of the competitors, and therefore their survival, are determined by relative abilities.

However, performance samples are often rather small. For small performance samples, relative position no longer depends exclusively on ability but is a joint consequence of ability and reliability. If the survival criterion is severe (i.e., only the very best survive), survival is heavily dependent on having a performance draw that is extreme. Thus, in such a case, improving average ability through learning helps relatively little, and increasing reliability (reducing variability) through learning hurts survival. If learning increases reliability substantially and a mean performance only a little (e.g., standardization, simplification) it is not good for competitive advantage when the number of competitors is large. Finishing first in a large field requires not just doing things well but doing something different and being lucky enough to have that particular deviation pay off.

It may be no accident that while experience (as reflected in years of prior work) and knowledge of standard beliefs (as reflected by success in school) are fair predictors of individual success in organizations on average, very conspicuous success in highly competitive situations is not closely related to either experience or knowledge as conventionally defined. Establishing preeminence involves exploration. Exploration is, on average, unfruitful, but it is the only way to finish first. Once a position of primacy is established by good fortune, it can be solidified and maintained for a reasonable period through exploitation. As learning exploits the gains that lucky ignorance produces, however, the advantage is very likely to be lost to some new fortunate exploratory behavior on the part of others.

Sustaining exploration

Although there are clear occasions on which organizations need to stimulate exploitation and restrain exploration, the more common situation is one in which exploitation tends to drive out exploration. This phenomenon has sometimes been explained as stemming from established firms not wishing to make their own products

obsolete (Reinganum, 1989). The explanation suggested here is somewhat different. Learning processes are driven by experience. Exploitation generates clearer, earlier, and closer feedback than exploration. It corrects itself sooner and yields more positive returns in the near term. As a result, the primary challenge to sustaining an optimal mix of exploration and exploitation is the tendency of rapid learners and successful organizations to reduce the resources allocated to exploration. Proposed solutions to the problem of sustaining exploration ordinarily operate on either incentives, organizational structure, individual beliefs, or selection processes.

The role of incentives

The classic economic response to sustaining exploration is one of incentives (Reinganum, 1989). In particular, the assignment of property rights to successful search activity is a prime focus of economic analysis of innovative activity. The presumption is that monopoly rights to successful innovations provide an incentive for bearing the risks of innovative activity. Thus, organizations and societies encourage exploration by bestowing enormous rewards on those few individuals associated with successful explorations and by providing safety-nets for exploratory failures.

Instruments such as patents change the actual return associated with exploration and are assumed to encourage exploration. Bankruptcy laws and the use of 'other people's money' in conjunction with the large rewards of a successful public offering, have been credited with fostering entrepreneurial activity in the United States. Organizations can offer similar incentive schemes. In general, however, organizational arrangements seem to be more effective in removing downside risks than in providing extremely rich rewards for great success.

The role of organizational structure

Organizational structure can be used to strengthen exploration by undermining the effectiveness of exploitation (Hedberg *et al.*, 1976; Hedberg and Jönsson, 1978). Failures to recall past lessons, to implement past solutions, to communicate about current problems, or to exchange feedback all contribute to inefficiency in refining current

practice, thus to the development of experiments—all of them foolish, most of them distinctly unrewarding, but an occasional one or two containing the seeds of a new direction (March, 1988).

It should be observed, of course, that the distinction between exploitation and exploration becomes somewhat confounded by variations in perspective. Effectively segregated exploitation, for example in new venture subunits (Burgelman, 1988), results in activities that contain considerable variation and exploration from the point of view of a higher organizational level. The dangers of such a procedure are obvious. The expected return is modest, and the most likely outcome is not exploratory behavior but a variety of uncoordinated exploitation.

Organizations may also try to design structures that avoid excessive socialization of new members. In a socialization process, two things are happening at the same time: (1) The code of received knowledge is learning from the beliefs and practices of individuals. (2) Individuals are learning the code. In such a system of mutual adaptation, individuals 'get ahead' by learning the code as rapidly as possible. The code, on the other hand, develops by learning from individuals who deviate from the code in a useful way. Thus, there is a system-level, long-term advantage in slowing socialization to the code (so that the code can learn), but an individual-level, short-run advantage in speeding socialization (March, 1991). Organizational structures that encourage rapid acculturation and socialization reduce the capabilities of the organization to learn from individual deviance.

The role of beliefs

Studies of risk taking suggest there are two major ways in which beliefs affect risk taking. The first is by influencing *risk preference*, the propensity to engage in apparently risky behavior. The second is by influencing *perceived risk*, the estimates that decision makers make about the riskiness of the alternatives they consider. Organizations affect risk preferences by influencing aspirations. They influence perceived risks by selecting and promoting individuals with particular experiences.

Influencing risk preference.

Numerous studies of risk taking behavior have indicated that risk taking is affected by the

relation between current (or expected) outcomes and aspirations for them. Individuals who find themselves in the neighborhood of their aspiration levels tend to act in a more risk averse manner when they are above their aspiration levels than when they are below them. When operating below the aspiration level, individuals seem to increase risk taking as they fall further below the target until they approach (and focus on) a survival point, when they become distinctly risk averse. Above the aspiration level, risk taking seems to rise slowly with success. In general, therefore, exploratory behavior is associated with failure (until survival is in question) and with substantial success. Modest success is associated with risk aversion (MacCrimmon and Wehrung, 1986; March and Shapira, 1987).

Most of the time, learning keeps performance and aspirations fairly close together. Performance adjusts to aspirations; aspirations adjust to performance (March and Simon, 1993). This tendency to keep performance and aspirations close tends to keep a focus on exploitation, rather than exploration. Where aspirations are strictly self-referential (that is, where current aspirations are a mix between immediate past performance and immediate past aspiration), greater risk taking is associated with slower adaptation of aspiration levels and with slower improvement in performance. Slowly adjusting aspirations and performance allow performance and targets to diverge, tending on average to increase the taking of risky actions. On the other hand, where aspirations are tied to the performance of superior performers in a population, aspiration adjustment tends to make most actors fail and to take risks. In such a case, higher levels of risk taking are associated with those who learn slowly how to improve performance and learn rapidly to aspire for the performance of superior others (Lopes, 1987; March and Shapira, 1992).

Influencing perceived risk.

One way of producing more exploratory behavior is through ignorance, through misperception of its risks. Successful organizations build a 'can do' attitude. This 'can do' attitude is likely to be especially prevalent in young, high growth organizations where the experience of managers leads them to believe they know the secrets of beating the odds. Successful managers (and the

journalists and folk-story artists who record their stories) tend to underestimate the risk they have experienced and the risk they currently face, and intentionally risk-averse decision makers may actually be risk seeking in behavior.

This inducement of risk underestimation may, of course, be useful for the organization or for the population of organizations. On the one hand, it is a way of compensating for the negative effects of success on risk taking. On the other hand, it is a way of inducing the individually self-sacrificing risk taking that serves the organization and the larger society. In situations in which risks must be taken in order to be successful, most overconfident individuals and organizations will undoubtedly perish to the risks they unwittingly face. But only the overconfident will ever be heroes. Actors in high performance, quick decision, high risk professions all share a common professional stereotype of being unusually confident. Overconfidence often leads to disaster, but in some situations organizations or populations of organizations profit from the individual foolishness that unwarranted self-confidence provides.

The role of internal selection.

Organizations promote individuals with experiences that make them confident of their own abilities and of the relevance of those abilities to organizational outcomes. Suppose every outcome that is experienced is a joint consequence of something that might be called 'capability' and something that might be called 'luck.' Across a population of learners whom luck neither favors nor disfavors, there will be no systematic bias in the experience of good fortune. However, if we partition the population into two groups on the basis of relative success, the sample of relatively unsuccessful people will have drawn a set of past experiences that was, on average, less favorable than they should expect in the future. Conversely, the sample of relatively successful people will have drawn a set of experiences that was, on average, more favorable than they should expect in the future.

The selection practices of organizations typically over-sample successful people. That is, indeed, their intention. People who have been successful in the past are retained and promoted to greater influence. People who have been unsuccessful in the past are removed or demoted to positions of lesser influence. The learning

consequence is that organizations systematically under-sample failure. High level managers are likely to anticipate a better world than they will experience, to assume that they are running fewer risks than they actually are, and to expect that they can control their destinies more than they actually can.

In short, their past successes give executives an illusion of control (Langer, 1975). Their experience makes them confident in their ability to handle future events, leads them to believe strongly in their wisdom and insight (Einhorn and Hogarth, 1978). They have difficulty in recognizing the role of luck in their achievements. These illusions are furthered by organizational folklore. In addition to promoting successful people, organizations actively foster beliefs in the control exercised by managers. There is sample selection bias in the stories told of past exploration efforts. Efforts associated with successful outcomes tend to be more popular stories. Those stories focus on the successful outcome as if it were an inevitable outcome of individual and organizational actions, ignoring many likely (but not experienced) paths toward failure.

LEARNING AND STRATEGIC MANAGEMENT

Strategic management is the art of dealing intelligently with three grand problems of decision making:

1. The problem of *ignorance*—uncertainty about the future and the past and the causal structure of the world.
2. The problem of *conflict*—multiple nested actors confronting multiple nested time perspectives with preferences and identities that are inconsistent across individuals and across time.
3. The problem of *ambiguity*—lack of clarity, instability, and endogeneity in preference and identities.

Human imagination seems capable of providing only rather restricted, incomplete 'solutions' to any of these problems. Each succeeding metaphor for strategic management has been found to have flaws.

Organizational learning is no exception. Designing organizations to learn from experience and to exploit the knowledge of others is possible, and such designs are major contributions to organizational intelligence. But closer examination of learning as a route to intelligence suggests that learning is less than a panacea for organizations. The contributions of learning to intelligence are constrained by three major problems of myopia:

1. *Temporal myopia.* Learning tends to sacrifice the long run to the short run. Effective learning requires exploration, but the difficulty of sustaining exploratory behavior is a problem that is accentuated, rather than relieved, by learning. As learning develops distinctive competencies and niches, it simultaneously compromises capabilities outside those competencies and niches. When conditions change, the learned skills become impediments. There is, of course, no assurance that the organizational problem is solvable. An organization cannot survive in the long run unless it survives in each of the short runs along the way, and strategies that permit short-run survival tend to increase long-run vulnerability. A possible option for individuals or sources of capital is to move in and out of organizations as entrepreneurs, leaving others to experience their decline, but this may be scant comfort to those who suffer the fate of the specific organization.
2. *Spatial myopia.* Learning tends to favor effects that occur near to the learner. The 'social welfare' aspects of the distribution of the effects of learning over space make strategic management itself problematic. In particular, the contribution of component self-destruction to system endurance poses a problem. Most students of strategic management have little difficulty in subordinating the interests of individuals and subunits in an organization to the interests of the organization. They focus their attention on maintaining the survival of the firm or other organization and recommend policies of reorganization and restructuring that seriously compromise the prosperity and survival of components of the organization. By extension, we might anticipate that students

of strategic management would similarly favor survival of the firm over the interests of larger systems of which the firm is a component (at least until hired by the larger system). The conflict is illustrated in contemporary politics by the contrast between advocates of free competitive markets and advocates of current businesses. The latter (like students of strategic management) seek to support existing firms in their struggle for survival; the former seek to strengthen the selective pressures of the environment.

3. *Failure myopia.* Organizational learning oversamples successes and undersamples failures. Any learning process tends to eliminate failures, and this tendency is accentuated by the way learning produces confidence and confidence produces favorable anticipations and interpretations of outcomes. The undersampling of failures is also a consequence of organizational selection processes. Organizations promote successful people. On average, successful people have drawn experiences that have been more favorable than they should expect to continue, and unsuccessful people have drawn experiences that have been less favorable than they should expect in the future. Learning does not easily correct for these biases in experience. Since these elements of over-confidence may be necessary to overcome the learning pressures toward exploitation, they may actually be useful in sustaining exploration.

All of these elements of myopia compromise the effectiveness of learning. In particular, they complicate the problem of maintaining an appropriate balance between exploitation and exploration. For the most part, they lead learning organizations to have difficulty in sustaining adequate exploration. The imperfections of learning are not bases for abandoning attempts to improve the learning capabilities of organizations, but they suggest a certain conservatism in expectations. Conservative expectations, of course, will not always enhance the selling of learning procedures to strategic managers, but they may provide a constructive basis for a realistic evaluation and elaboration of the role of learning in organizational intelligence. Magic would be nice, but it is not easy to find.

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REFERENCES

- Abernathy, W. J. and K. Wayne (1974). 'Limits of the learning curve', *Harvard Business Review*, **52**, pp. 109–119.
- Argote, L., S. L. Beckman and D. Epple (1990). 'The persistence and transfer of learning in industrial settings', *Management Science*, **36**, pp. 140–154.
- Argyris, C. and D. Schön (1978). *Organizational Learning*. Addison-Wesley, Reading, MA.
- Björkman, I. (1989). *Foreign Direct Investments: An Empirical Analysis of Decision Making in Seven Finnish Firms*. Svenska Handelshögskolan, Helsinki.
- Boeker, W. (1989). 'The development and institutionalization of subunit power in organizations', *Administrative Science Quarterly*, **34**, pp. 388–410.
- Bower, J. L. and T. M. Hout (1988). 'Fast-cycle capability for competitive power', *Harvard Business Review*, **66**, pp. 110–118.
- Brehmer, B. (1980). 'In one word: Not from experience', *Acta Psychologica*, **45**, pp. 223–241.
- Burgelman, R. A. (1988). 'Strategy-making as a social learning process: The case of internal corporate venturing', *Interfaces*, **18**, pp. 74–85.
- Burgelman, R. A. (1990). 'Strategy-making and organizational ecology: A conceptual framework'. In J. V. Singh (ed.), *Organizational Evolution*. Sage Publications, Newbury Park, CA, pp. 164–181.
- Chandler, A. (1962). *Strategy and Structure*. MIT Press, Cambridge, MA.
- Cohen, W. M. and D. A. Levinthal (1989). 'Innovation and learning: The two faces of R&D', *Economic Journal*, **99**, pp. 569–590.
- Cohen, W. M. and D. A. Levinthal (1990). 'Absorptive capacity: A new perspective on learning and innovation', *Administrative Science Quarterly*, **35**, pp. 128–152.
- Cohen, W. M. and D. A. Levinthal (forthcoming). 'Fortune favors the prepared firm', *Management Science*.
- Cross, J. G. (1983). *A Theory of Adaptive Economic Behavior*. Cambridge University Press, New York.
- Cyert, R. M. and J. G. March (1992). *A Behavioral Theory of the Firm* (2nd ed). Blackwell, Oxford.
- David, P. A. (1985). 'Clio and the economics of QWERTY', *American Economic Review*, **75**, pp. 332–337.
- Deutsch, K. W. (1966). *Nerves of Government*. Free Press, New York.
- Dierickx, I. and K. Cool (1989). 'Asset stock accumulation and sustainability of competitive advantage', *Management Science*, **35**, pp. 1504–1511.
- Einhorn, H. and R. Hogarth (1978). 'Confidence in judgment: Persistence in the illusion of validity', *Psychological Review*, **85**, pp. 395–416.
- Feldman, M. S. (1989). *Order without Design: Information Production and Policy Making*. Stanford University Press, Stanford, CA.
- Fischhoff, B. (1980). 'For those condemned to study the past: Reflections on historical judgment'. In R. A. Shweder and D. W. Fiske (eds.), *New Directions for Methodology of Behavioral Science*. Jossey-Bass, San Francisco, CA, pp. 79–93.
- Gulick, L. H. and L. Urwick (eds.) (1937). *Papers on the Science of Administration*. Columbia University Institute of Public Administration, New York.
- Hannan, M. T. and J. Freeman (1984). 'Structural inertia and organizational change', *American Sociological Review*, **49**, pp. 149–164.
- Hedberg, B. L. T., P. C. Nystrom and W. H. Starbuck (1976). 'Camping on seesaws: Prescriptions for a self-designing organization', *Administrative Science Quarterly*, **21**, pp. 41–65.
- Hedberg, B. L. T. and S. Jönsson (1978). 'Designing semi-confusing information systems for organizations in changing environments', *Accounting, Organizations and Society*, **3**, pp. 47–64.
- Herriott, S. R., D. A. Levinthal and J. G. March (1985). 'Learning from experience in organizations', *American Economic Review*, **75**, pp. 298–302.
- Hirschman, A. O. (1970). *Exit, Voice and Loyalty*. Harvard University Press, Cambridge, MA.
- Jones, J. W. and R. McLeod, Jr. (1986). 'The structure of executive information systems: An exploratory analysis', *Decision Sciences*, **17**, pp. 220–249.
- Kahneman, D. and D. Lovallo (1993). 'Timid choices and bold forecasts: A cognitive perspective on risk taking', *Management Science*, **39**, pp. 17–31.
- Keen, P. and M. S. Morton (1978). *Decision Support Systems: An Organizational Perspective*. Addison-Wesley, Reading, MA.
- Kuhn, T. S. (1970). *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago, IL.
- Langer, E. J. (1975). 'The illusion of control', *Journal of Personality and Social Psychology*, **32**, pp. 311–328.
- Lant, T. K. (1992). 'Aspiration level adaptation: An empirical exploration', *Management Science*, **38**, pp. 623–644.
- Lave, C. A. and J. G. March (1993). *An Introduction to Models in the Social Sciences* (2nd ed). University Press of America, Lanham, MD.
- Levinthal, D. A. and J. G. March (1981). 'A model of adaptive organizational search', *Journal of Economic Behavior and Organization*, **2**, pp. 307–333.
- Levitt, B. and J. G. March (1988). 'Organizational learning', *Annual Review of Sociology*, **14**, pp. 319–340.
- Lopes, L. L. (1987). 'Between hope and fear: The psychology of risk', *Advances in Social Psychology*, **20**, pp. 255–295.

- Lorange, P. (1980). *Corporate Planning*. Prentice Hall, Englewood Cliffs, N.J.
- Lounamaa, P. and J. G. March (1987). 'Adaptive coordination of a learning team', *Management Science*, **33**, pp.107–123.
- Lucas, R. E. (1988). 'On the mechanics of economic development', *Journal of Political Economy*, **22**, pp. 3–42.
- MacCrimmon, K. R. and D. A. Wehrung. (1986). *Taking Risks: The Management of Uncertainty*. Free Press, New York.
- March, J. G. (1988). *Decisions and Organizations*. Blackwell, Oxford.
- March, J. G. (1991). 'Exploration and exploitation in organizational learning', *Organization Science*, **2**, pp. 71–87.
- March, J. G. (forthcoming 1994). 'The evolution of evolution'. In J. Baum and J. V. Singh (eds.), *The Evolutionary Dynamics of Organizations*. Oxford University Press, New York.
- March, J. G. and J. P. Olsen (1989). *Rediscovering Institutions: The Organizational Basis of Politics*. Free Press, New York.
- March, J. G. and Z. Shapira (1987). 'Managerial perspectives on risk and risk taking', *Management Science*, **33**, pp. 1404–1418.
- March, J. G. and Z. Shapira (1992). 'Variable risk preferences and the focus of attention', *Psychological Review*, **99**, pp. 172–183.
- March, J. G. and H. A. Simon (1993). *Organizations*. Blackwell, Oxford.
- March, J. G., L. S. Sproull and M. Tamuz (1991). 'Learning from samples of one or fewer', *Organization Science*, **2**, pp. 1–13.
- Miller, D. T. and M. Ross (1975). 'Self-serving biases in the attribution of causality', *Psychological Bulletin*, **82**, pp. 213–225.
- Ostroff, F. and D. Smith (1992). 'The horizontal organization', *McKinsey Quarterly*, **1**, pp. 148–168.
- Prahalad, C. K. and G. Hamel (1990). 'The core competence of corporation', *Harvard Business Review*, **68**, pp. 79–91.
- Reinganum, J. J. (1989). 'The timing of innovation: Research, development, and diffusion'. In R. Schmalensee and R. D. Willig (eds.), *Handbook of Industrial Organization*. North-Holland, New York. pp. 849–908.
- Romer, P. M. (1986). 'Increasing returns and long-run growth', *Journal of Political Economy*, **94**, pp. 1002–1036.
- Sagan, S. D. (1993). *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons*. Princeton University Press, Princeton, NJ.
- Schelling, T. C. (1960). *The Strategy of Conflict*. Oxford University Press, New York.
- Schonberger, R.J. (1990). *Building a Chain of Customers*. Free Press, New York.
- Senge, P. M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday, New York.
- Stalk, G., P. Evans and L. E. Shulman (1992). 'Competing on capabilities: The new rules of corporate strategy', *Harvard Business Review*, **70**, pp. 57–69.
- Starbuck, W. H. (1983). 'Organizations as action generators', *American Sociological Review*, **48**, pp. 91–102.
- Thompson, J. D. (1967). *Organizations in Action*. McGraw-Hill, New York.
- Udayagiri, N. D. and S. Balakrishnan (1993). 'Learning curves and knowledge spillovers: The case of semiconductor memories'. Jones Center Working Paper, Wharton School, University of Pennsylvania.
- Weick, K. (1979). *The Social Psychology of Organizing* (2nd ed.). Addison-Wesley, Reading, MA.
- Yelle, L. E. (1979). 'The learning curve: Historical review and comprehensive survey', *Decision Sciences*, **10**, pp 302–328.