Archetypal self-reinforcing structures in organizations:
A system dynamics perspective of cognitive, social, and institutional processes

Anjali Sastry
University of Michigan Business School
701 Tappan Street
Ann Arbor MI USA 48109-1234
(734) 763-1591
masastry@umich.edu

June 1998

Psychology, sociology, economics, and organizational studies have identified cognitive, social, and institutional processes that appear to shape a wide range of social systems. This existing research provides the starting point for an exploration of specific feedback processes that recur in a variety of settings. In a sense, the resulting generic structures offer an alternative to the archetypes from the systems thinking literature. The present focus is five areas of research on organizations—learning by doing, imprinting, escalation of commitment, institutional isomorphism, and diffusion—that explain how past decisions and actions are reinforced within organizations and in communities of organizations. Some two dozen self-reinforcing processes that account for history dependence in social systems emerge from an analysis of the research in these areas. Such generic processes grounded in existing theoretical and empirical traditions have much to offer system dynamicists interested in organizations. The feedback loops and related bodies of research provide a ready-made collection of valuable ideas for modelers to draw on in trying to understand dynamics of real-world organizations. The resources presented here will be useful in building models, developing links between system dynamics and other forms of research, and making work in our field (and in others) more cumulative.

Some of the work presented in this paper was carried out jointly with Corinne Coen, to whom I am grateful for research assistance.

System dynamicists' search for generic structures has proved challenging. The promise is that if we could identify the feedback processes responsible for common problems, and pair system structures and resultant behaviors with each, we would be able to diagnose, understand, and even remedy the problems we encounter in social systems. Potential payoffs for practitioners are evident—a well-defined and validated set of generic structures would serve as building blocks for system dynamics models, and may provide shortcuts to developing insight into causes, consequences, and treatment of problems. As Lane and Smart recently reminded us (1996), the field of system dynamics appears to have been much influenced by Forrester's assertion that "probably twenty basic structures would span 90% of the policy issues that most managers encounter" (Forrester 1980: 18). No wonder so much attention has been devoted to the search for these fundamental feedback processes.

Despite the promise offered by generic structures, debate continues about the progress that system dynamics has made towards this goal (Lane and Smart 1996). Some see the archetypes popularized by advocates of systems thinking in *The Fifth Discipline* publications and practice (Senge 1991; Senge *et al* 1994), the work of Pegasus Communications (e.g., Kim 1996), and others (e.g., Bellinger 1998) as important contributions towards our understanding of generic structures. Taking the form of such generic counter-intuitive system archetypes as "Shifting the Burden," "Fixes That Backfire," and "Accidental Adversaries" (Senge *et al*. 1994: 125-150), these feedback loop structures are promoted as tools for systems thinking that can be applied in a wide range of organizational settings to both diagnose problems and generate solutions.

Systems thinking advocates suggest that archetypes are easy to apply: "You start by making guesses…Some people worry that they will apply the 'wrong' archetype, misdiagnose the problem, and make things worse. In practice, this doesn't happen" (Goodman and Kemeny 1994: 121-122). Yet others note the difficulties in applying and analyzing the implications of systems archetypes (Lane and Smart 1996; Sterman 1994). One critique of the archetypes approach concerns the limitation of causal loop diagrams as tools for analysis: loop polarity is difficult to establish via such diagrams alone; and behavior is notoriously difficult to infer from even a simple set of loops (Morecroft 1982; Richardson 1986; Sterman 1994).

System dynamics provides solutions to this first set of problems. Alternative diagramming tools—such as stock and flow maps and policy structure diagrams—are useful in conceptualizing and representing feedback structure and avoid some of the problems inherent in causal loop diagrams; and of course the process of building and testing computer models of the situation of interest allows the researcher or practitioner to correctly infer how the processes interact and change over time. Fitting a generic model to a specific dynamic system can help validate the generic model, while also exposing other features of the situation—such as additional feedback loops—that may have escaped attention.

Other critiques of the archetypes are linked to apparent ambiguity in the language, questions about their use and application, and difficulties in formalizing them (Dowling *et al*. 1995; Lane and Smart 1996). Particularly contentious is the suggestion that one can

infer structure from behavior and select an appropriate antidote to existing problems, all without formulating and simulating a model (Sterman 1994; Lane and Smart 1996). However, as work by members of the Society for Organizational Learning and other systems thinkers progresses and the archetypes are refined—as more people follow Sterman's advice to use the archetypes as working hypotheses to be tested by computer simulation—these issues may be resolved.

Yet such an approach taking the systems archetypes as a starting point may miss significant opportunities to link work in system dynamics with findings from other fields and to build better models and theories. The archetypes approach may also focus attention at such a general level of analysis that insight, transfer, and testing are made more difficult than they would be if mechanisms of change were more specifically described. In addition, while there appears to be no reason why more traditional computer-based system dynamics models built for research or practice should not follow Sterman's advice and draw on, elaborate, verify, and extend archetypes, we see little evidence that this is happening. For instance, archetypes are absent in recent presentations of models appearing in the *System Dynamics Review* and elsewhere.

Does this mean that the search for common basic feedback processes has been abandoned? Not according to Lane and Smart, who point to two alternative approaches to generic structure in system dynamics: canonical situation models, or general models of an application domain, such as Forrester's market growth model (Lane and Smart 1996: 91); and abstracted micro-structures, more transferable chunks of a simulation model that can

be paired with behavior modes that they generate, such as “overshoot and collapse” (Lane and Smart 1996: 96). While both approaches have been very productive for the field, they fall short of providing us with theories that explain and predict the often problematic behavior of social systems—precisely the area that the systems thinking archetypes attempt to address. Generic structures that represent cognitive and social processes shown to operate in a wide variety of settings could help system dynamicists to build better models, develop hypotheses to test, generate alternative explanations for observed behavior, and explain macro-level behavior in terms of micro structures. They could also help link existing and new system dynamics work with research in other fields, while making our work—as well as that of others—more cumulative, thus addressing system dynamics’ need for what Richardson (1996) has labeled “a culture of accumulation.”

Luckily, we have much to draw on. Feedback loops are central to processes studied by sociologists, psychologists, economists, and organizational scholars (Richardson, 1991; Masuch, 1985). Such processes have been studied with a variety of research methods, from experiments to case studies; many have long and rich histories, and consequently have been extensively tested and validated. While the terminology and language employed within each field and sub-field differ, and while feedback loops may be more or less clearly articulated in the literature, feedback processes are nevertheless key in a wide range of fields that study change over time.

Many of the same processes studied by other organizational researchers have been identified by system dynamicists, and existing system dynamics models already may—and

many do—incorporate elements of the processes studied in other fields. For instance, the classic self-reinforcing process of learning by doing appears in many system dynamics models (e.g., Sterman and Richardson 1985; Sterman, Repenning and Kofman 1997). Yet the terminology and specific feedback structures chosen to represent the phenomenon often differ across models, and it is often difficult to establish whether a given model includes the effect.. As a result, the field may miss opportunities to identify similarities between apparently different models and application domains and to improve the formulation and testing of the common model elements. For example, the learning-by-doing structure may appear in more models than is immediately evident from the literature (for instance, the effect may be at work in such models as the Fossil2 energy model (Naill 1992) and Mashayekhi's solid waste model (1993), although it is not evident from published papers on these models). Yet despite the relatively simple nature of learning by doing, a careful consideration of the phenomenon suggests many questions that could lead modelers to new insights. For instance, economies of scale (present in Mashayekhi's model) may substitute for learning effects, or may complement them. Learning effects may generate advantages for one actor, technology, or organization that are more or less permanent depending on the appropriability of the learning—which may itself be affected by policy choices. The extent to which learning can be transferred depends at least in part on the extent to which the acquired knowledge resides in individuals (e.g., in their skills) versus in the organization (e.g., in its operating procedures and routines). Similarly, the extent to which learning can be encouraged by management also varies across situations. Developing a body of knowledge about generic structures would help to highlight such issues for a wide range of system dynamics research.

The aim of this paper is to propose an alternative approach to generic structures: why not take the large body of existing research on organizations as the starting point, and look for recurring feedback processes that have already been found in a variety of settings and explored in the literature? Such research can offer system dynamicists ready-made—and already tested—feedback loops to choose from, as well as questions to ask, extensions to consider, and rival hypotheses to explore. Documented case studies provide histories against which the results of computer simulations can be compared. Perhaps most importantly, the processes that generate behavior at psychological, interpersonal, organizational, and institutional levels are described, suggesting variables that are easily measured and compared. Rather than the general level of analysis at which systems archetypes operate, the processes explored here work at specific cognitive or social levels. The resulting causal loop diagrams are resources that any system dynamicist can draw on to understand the processes uncovered in the course of building models of particular organizations or social systems, as well as to develop and explore generic structures at work in social systems.

To bound the present study, we confine attention here to theories that explain why history, in the form of past events, initial conditions, and early choices, is important to social systems. History dependence is one important type of counter-intuitive behavior seen in organizations, since systems that are shaped by their past may resist efforts to change them and may lock in to apparently sub-optimal states. Self-reinforcement is central to five areas of organizational research—imprinting, learning by doing, escalation of commitment, institutional isomorphism, and diffusion. Analyzing the generic processes that shape

behavior in each yields some two dozen positive feedback structures that influence a wide variety of social systems.

Methods

A natural starting point for finding self-reinforcing processes was to search the existing published organizational research for references to positive feedback, history dependence, vicious and virtuous circles, self-reinforcement, and path dependence. Drawing on the Social Sciences Citation Index, our own reading, indexes of survey books and collected papers, suggestions from colleagues, the internet, ABI Inform, and other sources, we looked for candidate articles, research papers, and books. The multiple search strategies rapidly converged and the five main areas of research emerged.

The next step was to identify the papers that best captured the key ideas of each set of theories. In some areas, survey articles were helpful; in others, early foundational articles were the best source; and in still other areas, more recent publications gave a good overview of the theory. Treating each paper or set of papers as our data sources, next we analyzed each text to identify key processes. The result was a set of causal loop diagrams grounded in the original theoretical and empirical work in each research area. Interestingly, difficulties in constructing causal loop diagrams from existing research accounts in some areas of organizational studies may suggest problems with the underlying theories—in particular, missing or ambiguous feedback structures. For instance, the recent literature on organizational co-evolution does not present a clearly identifiable set of reinforcing processes and causal mechanisms, despite the focus on

mutual influence evident in the notion that organizations, technologies, institutions and belief structures evolve in concert (Garud and Rappa 1994; Nelson 1994; Van de Ven and Garud 1994).

A second check of the causal loop diagrams was provided by a review of additional experiments, field studies, and case research as well as theoretical extensions to the original ideas. In addition, because all the candidate theories are well-known, it has also been easy to solicit suggestions and criticism from others, which also helped to refine the analysis.

The five bodies of research that emerged from this analysis address organizational phenomena that are, at first blush, very different from each other. Explanations for *learning by doing* account for the tendency of people and organizations to improve performance over time. Cumulative experience leads to improvements in average costs, quality, or error rates. The result of these improvements is higher demand, which in turn facilitates additional improvements as more experience cumulates (Nelson and Winter 1982; Argote, Beckman, and Epple 1990). A different set of processes is at work when organizations maintain elements of founders' decisions, choices and approaches, or preserve aspects of early strategy or initial conditions, over time. The explanation for organizational *imprinting* identifies social and organizational processes responsible for the persistence of founders' practices, views, and policies (Kimberly 1979; Schein 1983; Boeker 1988; Eisenhardt and Schoonhoven 1990), the effects of early environmental conditions (Stinchcombe 1965), or initial strategy choices (Boeker 1988; Boeker 1989b;

Romanelli 1989). *Escalation of commitment* has been explained by a variety of psychological, social, and organizational processes that account for the increasing difficulty of changing once a course of action has been selected. Ongoing investments of time and effort into a chosen course of action results—even when it is an apparently poor choice (Staw and Ross, 1978; Staw, 1981; Staw and Ross, 1987; Staw and Ross, 1989). *Institutional isomorphism* explains why organizations grow to resemble others within their field. This similarity is caused by the spread of common norms and practices, the mimicking of peers, and the direct control of other, more powerful organizations or institutions (DiMaggio and Powell, 1983). Innovations may also spread through a population by processes of *diffusion, bandwagons, and fads*. Cognitive and social factors shape the adoption process (Rogers, 1983; Valente, 1995).

Each of the five areas together with a description and diagram of the key feedback loops is described in the sections that follow. We turn to each of these areas next, and then step back to assess what we have learned.

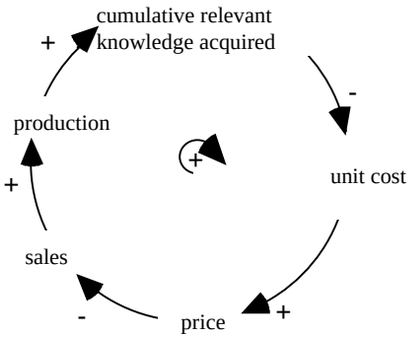
Learning by doing

The literature on learning by doing details the processes by which people and organizations become better at what they are doing as a result of experience (Nelson and Winter 1982; Argote, Beckman and Epple 1990). Practice in producing a product or in delivering a service results in greater understanding of the required processes as people "work out the kinks" and solve problems as they encounter them, learn to coordinate with others and improve the timing of interactions, discover short cuts, develop supporting

tools and technologies, refine the equipment they use, and evolve and elaborate working rules, policies, procedures and norms to support production. Organizational learning of this sort takes place when unit costs decrease as a function of knowledge acquired through production (Argote and Epple 1990). It also results when quality improves, or accidents, defects, or complaints per unit fall, as a product of experience. As cumulative experience builds, costs decline, efficiency improves, and quality increases, stimulating demand and consequently production; in turn, activities are repeated and tools used more as experience builds. The knowledge acquired as a result may be embodied in individuals—for instance in their skills—or may reside in the organization—for example, in its operating procedures and routines.

Figure 1 presents a template of the l*earning by doing* process. While the loop represents price reductions that result from cumulative experience driving down unit costs and hence generating demand and production, learning by doing may also operate in a similar process without price changes, via improved quality driving up demand and hence production.

Figure 1: Learning by doing loop



Constraints to the growth of organizational knowledge exist: the values of experience gained in production may depreciate rapidly (Argote, Beckman, and Epple, 1990; Argote and Epple, 1990). In empirical tests of both individual psychology and organizational processes, learning does not necessarily persist. Forgetting, turnover, the loss of records, obsolescence of knowledge, and disruption in practice all hasten the loss.

Imprinting

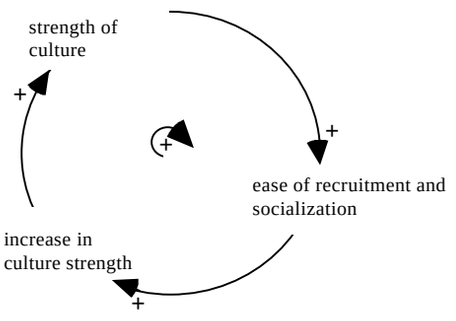
Imprinting, or founding effects, offer a second general type of self-reinforcing mechanism. This area of organizational research provides empirical evidence of the permanence of early choices, as well as some explanation of the processes that generate persistence. Over time, imprinted organizations become increasingly committed to early strategies, reinvesting their resources in employees with consonant skills, building sets of norms, practices and beliefs that promote the original vision, and refining policies to support the goals arising from their original strategies. Three factors shape the imprinted organization: the founder (Kimberly 1979; Schein 1983; Boeker 1988; Eisenhardt and Schoonhoven 1990); early choices and decisions (Boeker 1988; Boeker 1989b; Romanelli, 1989); and initial conditions (Stinchcombe 1965). Any of these may leave a lasting impression on the organization, influencing its strategy, culture, policies, and procedures in later life.

By setting forth expectations, shaping practices, and articulating a vision, founders establish the norms, practices and beliefs that guide recruitment and socialization and provide the starting point for further elaboration by organization members (Boeker 1988). As employees identify with founders, they reinforce the founders' behaviors by repeating

and elaborating them, generating pressure for the founders to continue. Through the process of socialization, new employees recreate the founders' fundamental assumptions, priorities, and strategies as they learn how to behave and interpret information in the organization, respond to the reward system, and model themselves after respected figures (Boeker 1989b). Such effects may persist even after the founder or founding team has left the organization or when the environment has changed. As the founders' habits, practices, and beliefs become institutionalized, reward systems evolve to encourage organizational members to sustain or repeat consistent actions (Boeker 1989b).

In Figure 2, the term "culture" represents the norms, practices, and beliefs that shape organizational members' behaviors and views. The processes involved in the *socialization and the elaboration of culture* feedback loop serve as reinforcing mechanisms (Schein 1983; 1985). As Figure 2 shows, as culture is strengthened, selection, recruitment and socialization of compatible members becomes easier; in turn, as homogeneity increases and cultural norms are better communicated, the culture is reinforced.

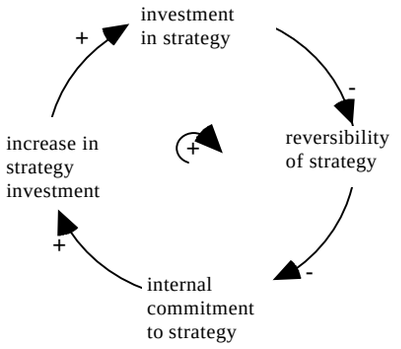
Figure 2: Socialization and culture loop



Once a firm chooses an initial strategy, adopts an organizational form, or elaborates procedures, it recruits employees with consonant knowledge and skills. Competencies for alternative practices may be undeveloped (Boeker 1989b). The longer a founder runs an organization, the more the manner of operating will be taken for granted (Boeker 1989b) by both employees and potential recruits.

In the realm of strategy, initial choices may be reinforced as further resources are invested and supporting policies are articulated. Similar processes are at work even when the initial choices are dictated by the environment instead of being selected by managers. In such a case, the conditions at founding—what Stinchcombe (1965) calls the "available social technology"—shape the organization's structure, strategic choices, and culture. In either situation, early choices persist because changing course is costly and investments are difficult to reverse, early practices quickly become taken for granted, and choices are elaborated into interconnected systems (Eisenhardt and Schoonhoven 1990), making the strategy less reversible over time (see Figure 3, depicting *strategy irreversibility*). The effect is further compounded when additional costly resources are invested or when obsolete technology, physical plant, or skills constrain choices (Stinchcombe 1965; Eisenhardt and Schoonhoven 1990).

Figure 3: Strategy irreversibility loop



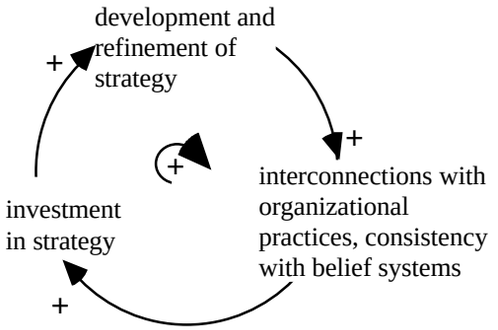
As a result, the more a firm invests in a strategy, the more difficult it becomes to change (Boeker 1989b). Information gathering and decision-making evolve to support the strategy, further reinforcing the internal consensus. Subsequently, other strategic options are rarely considered. Commitment builds through the investment in facilities, personnel, practices and policies uniquely suited to that strategy; the strategy becomes less and less reversible over time as a result. The networks of relationships among members of the firm influence their ability to perform and the creation of consensus (Boeker 1988), and these relationships evolve to support the strategy in use. As internal belief systems and power distributions develop, internal commitment to the strategy is reinforced, resulting in the strengthening of constituencies within the organization who support the status quo.

In a related process, the refinement of strategy affects the elaboration of practices and the expression of beliefs. Idiosyncratic conceptions of a founder or founding team, driven by their cognitive biases and personal beliefs, shape a firm's predilection toward a strategy (Boeker 1988). Early patterns of activity become "traditionalized" (Stinchcombe 1965) or routinized (Nelson and Winter 1982), limiting the variations considered for future practice.

Over time, strategy development becomes increasingly entwined with the belief system and traditional practices of the firm, rather than changing in response to environmental demands.

This process is represented in a reinforcing loop termed *values elaboration.* As the organization's strategy develops, supporting connections with other aspects of the organization are reinforced, lending increasing support to the strategy and resulting in more effort being directed to its development and refinement.

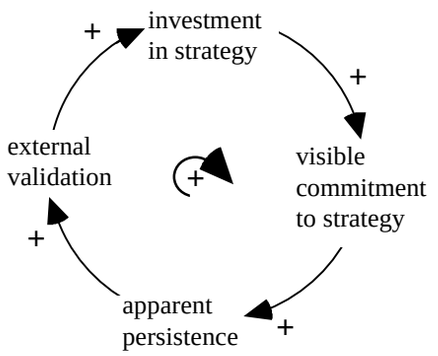
Figure 4: Values elaboration loop



In addition to the growing consistency of strategy and beliefs, planning and elaboration of procedures replace a founder's vision and invention (Mintzberg and Waters 1982). Once the founder departs from the firm, employees extrapolate appropriate behaviors from past practice or from policy, reinforcing the status quo. Where the founders may have felt free to change their vision at will, subsequent planners feel constrained to honor the plan that the founders articulated.

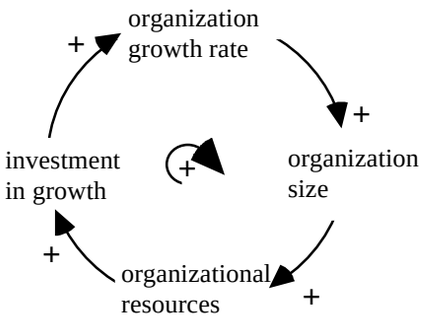
New organizations often face a crisis of legitimacy with external constituencies (DiMaggio and Powell 1983; Hannan and Freeman 1984). To address this problem, the organization makes increasing commitments to outside social forces (Stinchcombe 1965). Ideologies are elaborated to justify and sustain stable relations with external constituencies. New firms lack resources to shape the market and competitive conditions, but instead depend on legitimacy to support their demands and claims on others. An important antecedent of this external validation is the organization's apparent commitment to a course of action. The result of the effort to maintain the appearance of commitment is the increased support of these external parties to the original strategy. Thus, outside parties tend to invest more in organizations that appear validated; and apparent persistence—which is itself the result of the organization's making a visible commitment to a strategy—is the key driver of that validation. Once more is invested in a given strategic approach, the organization's commitment to the strategy is in even greater evidence, resulting in reinforcement of *visible commitment*.

Figure 5: Visible commitment loop



The final process is one named *resource accumulation*. It represents the simple principle that as the organization grows in size, it generates greater resources capable of further supporting its growth (Eisenhardt and Schoonhoven 1990). For instance, a small organization may not be able to invest in a customized training programs, whereas a larger organization may be able to afford this more efficient method of training and socializing employees. The investment in the training program thus both saves money and increases performance, supporting further growth of the organization.

Figure 6: Resource accumulation loop



What constrains these positive feedback loops? Empirical studies show that the effects of imprinting tend to decline with time (Romanelli 1992). Over time, these processes encounter diminishing returns: once an organization has become very effective in socializing entrants, homogeneity of its members will increase at a diminishing rate as the addition of one more similar member does little to change the organization's overall level of homogeneity. In addition, later events may prevent the perpetuation of initial strategies, alter norms or the balance of power across functions, disrupt commitment, or cut the flow of resources. The primary force that causes this disturbance is a drastic change in level of

performance (Boeker 1989b). Performance failures, in particular, may force a fundamental reordering of activities (Tushman and Romanelli 1985). In addition to market demands, changes in corporate legitimacy may induce organizational change (Aldrich 1979). The effect of initial conditions is also diminished by the departure of the founder or founding team and thus their reinforcing influence (Boeker 1989b; 1989a).

Escalation of commitment

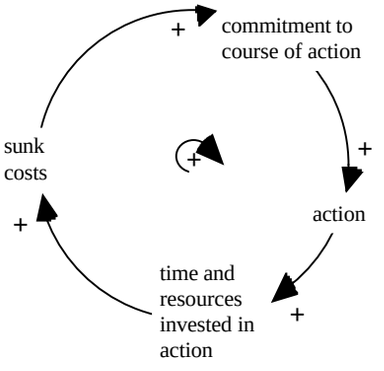
The research on escalation of commitment explains why people continue to invest time, money, and attention in losing courses of action (Staw 1976; 1981; Staw and Ross 1978; 1987; 1989). Contributing processes appear at multiple levels of analysis—psychological, social, and organizational—and different processes may dominate at different points in the organization's experience. Early, apparently "rational" choices may subsequently be reinforced because the decision-makers' aversion to change, the irreversibility of supporting investments, and organizational routinization, among other factors.

The story begins when organizational members choose one course of action over others. In allocating resources, time, effort, or money, people may make their initial choice for apparently rational reasons, such as cost-effectiveness or technical superiority. The very act of undertaking the actions, however, may generate other reasons for continuing its practice; the action or project can begin to generate a logic of its own that goes beyond the initial rationale. Some reasons for persisting are objectively rational: early losses may be expected if payoffs are known to follow some time after the initial investments; closing

costs may be substantial. Yet other contributors to escalating commitment are the psychological, social and political processes explored here.

If the choice entails an irreversible investment, decision-makers may consider their sunk costs to be evidence that the action should be continued. This "sunk cost effect" results in further investment which is justified not in terms of the initial rationale but because so much has already been invested (Staw and Ross 1989). In this process, the sunk cost itself is seen by the decision maker as a manifestation of commitment to the course of action, further reinforcing the choice, action, or investment and thus generating a *sunk cost* loop.

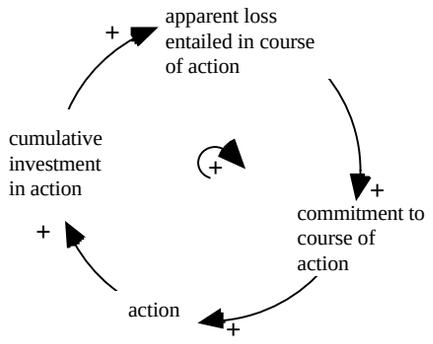
Figure 7: Sunk cost loop



A similar process is at work when individuals frame later choices as opportunities to remedy a past loss by making up for the cumulative investments already made (Staw and Ross 1989). If an action is not successful, the greater the investment, the greater the apparent loss entailed. Because of the common tendency to avoid loss (what psychologists call "loss aversion"), this cumulative investment—or apparent loss—can generate

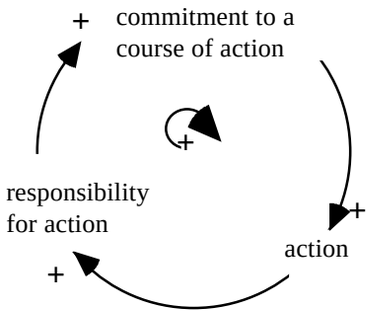
increased commitment to undertaking the action in the hopes of recovering past losses. This process is represented below in the *framing bias* loop.

Figure 8: Framing bias loop



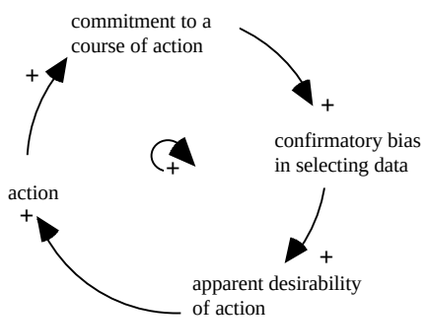
Alongside these two errors in interpreting information are processes that operate at the individual psychological level. For instance, the framing error is exacerbated by a second process when the person making subsequent investment decisions also made the initial choices: when they are responsible for past decisions, people are motivated to reinforce them so as to feel that they have "done the right thing" and therefore rationalize past actions (Staw and Ross 1989). We label this the *self-justification* process.

Figure 9: Self-justification loop



Contributing to this process is the tendency for decision makers to pay attention to data that supports (or is at least consistent with) their past decisions and to downplay conflicting information. This *confirmatory bias* may skew the basis on which subsequent decisions are made (Staw and Ross 1989); conflicting information is simply ignored and alternative courses of action therefore not considered.

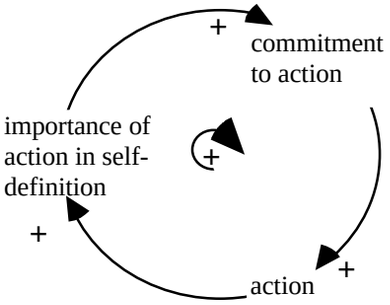
Figure 10: Confirmatory bias loop



Passive self-inference may also generate escalation of commitment (Staw and Ross 1989). Because people begin to define themselves in terms of the actions they take, an initial choice may be repeated as the decision makers form personal beliefs that define

themselves in terms of what they do. *Self-inference* is more pronounced when the action is repeated, important, voluntary, public, difficult to reverse, and easy to interpret.

Figure 11: Self-inference loop



At the interpersonal level, external justification may be important. Decision makers' fears of others inferring that they have made mistakes in the past may result in their reinforcing their initial decisions (Staw and Ross 1989). We label this the *face-saving* process. Similarly, external binding occurs when observers both form inferences about why the decision makers are undertaking the action and link those inferences to the decision makers' social identity (Staw and Ross 1989). As a result, observers identify the actors with the action, increasing the costs of withdrawal. We label this the *external binding* loop.

Figure 12: Face-saving loop

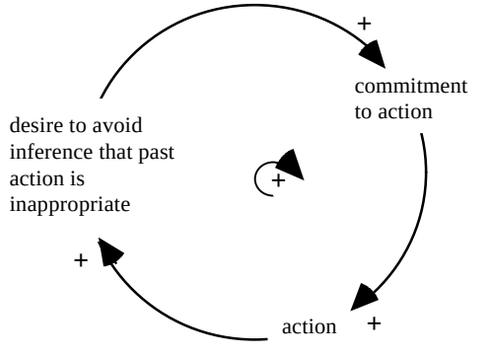
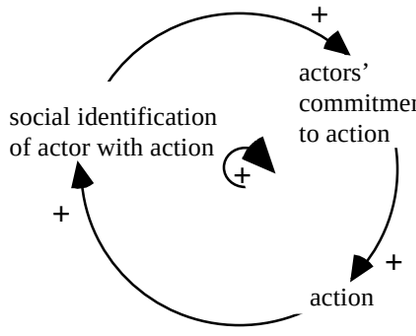
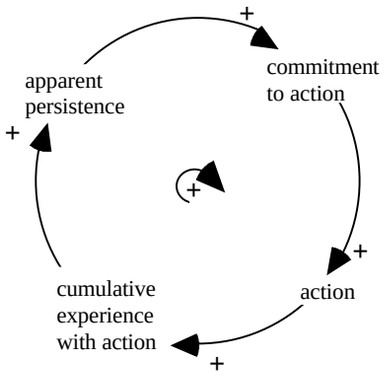


Figure 13: External binding loop



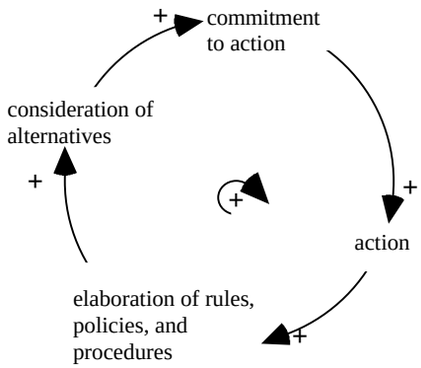
A third process at work in the social arena rewards decision makers for persistence (Staw and Ross 1989). Observers value the unswerving commitment manifested by decision makers who stay the course; interestingly, those who persevere in the face of bad outcomes may be revered more than those who adjust their actions to account for results (p. 218). The increased value placed on persistence leads to greater commitment to sustaining or repeating the action. We label this process *perseverance*.

Figure 14: Perseverance loop



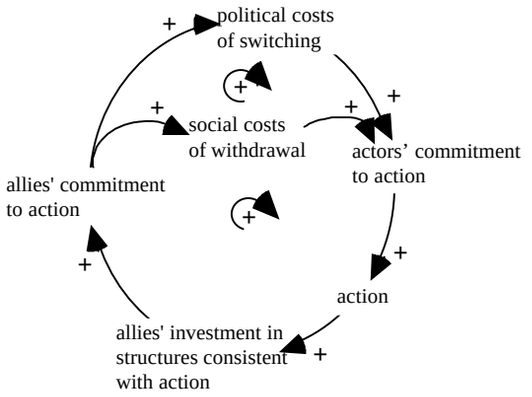
In addition to the increased perceived value related to persistence, as an early choice is first implemented within the organization, its members develop rules, policies, and procedures that are consistent with the selected course of action. Once established and elaborated upon, these structures filter information and make any change necessarily slow and difficult. As rules become elaborated, consideration of further alternatives declines, leading to increased commitment to the original choice (Staw and Ross 1989). Thus the processes by which organizational action becomes routinized lead to an *institutional inertia* loop.

Figure 15: Inertia loop



At the intra- or inter-organizational level, the behavior of political allies also shapes commitment to an action (Staw and Ross 1989). As decision-makers invest time and resources in an action, allies invest in consistent or complementary structures. The allies' investments create both political and social costs for withdrawing from an early choice. We label this the *political and social commitment* loops.

Figure 16: Political and social commitment loops



While the Staw and Ross (1989) paper both summarized past work and provided a foundation for future research on escalation of commitment, we see further development of these ideas in subsequent work. The research on escalation of commitment includes experimental (Staw 1976; Garland, Sandefur, and Rogers 1990; Heath 1995) and other empirical studies (Arkes and Blumer 1985; Ross and Staw 1993; Staw and Hoang 1995) as well as attempts to integrate conflicting theories (Brockner 1992). In recent investigations of the limitations of the theory—and in particular of the effects of task design on the tendency of people to continue investing in failing courses of action—we find a debate about the relative importance of the roles of the justification processes versus

the cognitive ones. Yet we observe general agreement that the processes described by Staw and Ross are those that generate escalation of commitment.

Institutional isomorphism

Different mechanisms for organizational history dependence are provided by institutional theory. Faced with uncertainty about how to solve a business or managerial problem, organizational members turn to the practices, structures, and solutions to common problems codified by their professional community, practiced by other organizations, or mandated by more powerful institutions (DiMaggio and Powell 1983).

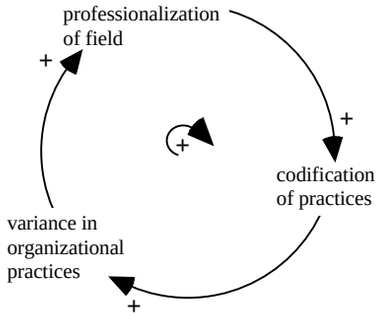
By adopting professionally sanctioned norms and practices, individuals and the organizations to which they belong develop legitimacy. They also grow to resemble others in their field. The result is normative isomorphism, or homogeneity in organizational structure, culture, or output resulting from the diffusion of occupational standards and practices. Professional practices spread in this manner include decision-making approaches, acceptable solutions to common problems, and norms for personal behavior, dress, and verbal communication (DiMaggio and Powell 1983). The process by which members of an occupation establish and propagate shared work standards, known as *professionalization*, is the primary vehicle of normative isomorphism.

Professional education is one key source of these occupational practices; social networks that cross organizations also propagate normative rules. On-the-job training, consultant relationships, industry associations, professional school networks, and trade magazines

serve as mechanisms for further reinforcing normative isomorphism. Organizations contribute to the process when they filter recruits or allocate promotions to favor those from within their industry, from a small number of schools, from an established background or with a set of defined skills (DiMaggio and Powell 1983).

At the individual level, professionalization spreads when organization members become socialized into the norms of a profession (DiMaggio and Powell 1983). As individuals limit their behaviors and choices to those consistent with the standards of their chosen profession, they narrow the number of alternative practices from which they draw solutions to organizational problems. As a result, such practices become further professionalized, making them easier to codify, communicate, and teach to others.

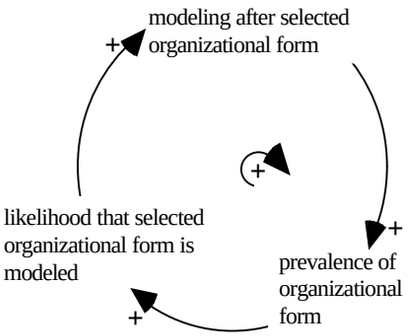
Figure 19: Professionalization loop



A second type of institutionalization involves learning from others. Copying can be an efficient means of addressing uncertainty. When an organization confronts technological uncertainty, ambiguous goals, unclear problems and solutions, or difficulty in establishing legitimation with others, its members may decide to adopt the practices or structures of

another organization. In addition, powerful stakeholders may encourage an organization to emulate practices of others in its field. The result is mimetic isomorphism, or a similarity of organizational structures within an organizational field that results when organizations model themselves after others(DiMaggio and Powell 1983).

Figure 18: Mimesis loop

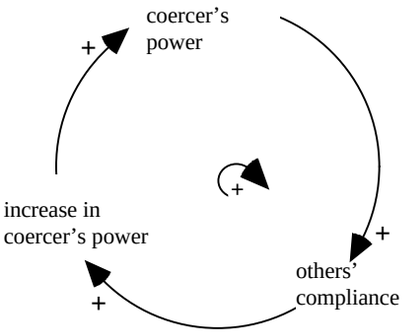


Organizations become increasingly similar through the following process: First, the prevalence of a particular organizational form drives the odds of its being selected as a model. Models may be selected on the basis of perceived legitimacy, apparent success, or convenience; the more common a form, the more likely it will be selected as a model. The more often it is copied, the greater its frequency in the population. The loop representing this process is labeled *mimesis*.

A third feedback process is associated with institutional isomorphism. Organizations are subject to common coercive forces from other, more powerful organizations and from the social system on which they are dependent. Such coercion takes the form of government mandates, persuasion or social pressure, legal constraints, technical requirements,

monopolistic control of resources, centralized banking practices, or the more subtle demands for ceremonial roles required for interacting with hierarchical organizations (DiMaggio and Powell 1983). As the coercive power of institutions that influence others increases, so does their ability to achieve compliance; increased compliance increases dependence of others on coercers, thereby reinforcing the coercive power, as the *coercive power* loop illustrates.

Figure 19: Coercive power loop



Diffusion, bandwagons, and fads

The literature on diffusion describes the process by which new ideas, technologies, or practices spread through a population as new adopters imitate, learn from, or otherwise glean information from others. Research on this topic examines how potential adopters select others as sources of information in deciding whether to take up the innovation.

Bandwagons represent a special case of the diffusion processes, in which the number of other adopters of an innovation is the key determinant of the decision to adopt (Rogers 1983; Bikhchandani, Hirshleifer, and Welch 1992; Abrahamson and Rosenkopf 1993;

Valente 1995; Abrahamson 1996). People or organizations may decide to adopt if they perceive pressure from peers or the public. Adopting the innovation may help them to gain legitimacy—to be seen doing the right thing—or to catch up with competitors.

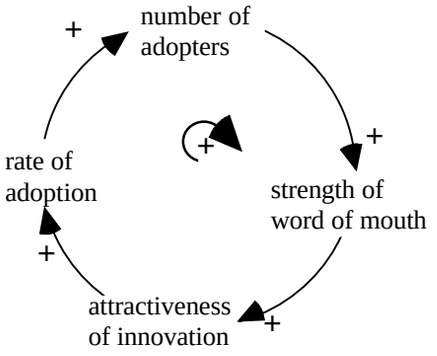
Diffusion may operate through social contagion or persuasion. Potential adopters rely on the data from others selected as sources of information because of their physical proximity, social stature, social similarity, or frequency of communication. The rate of diffusion depends on a number of factors, including an individual or firm's inclination to adopt the innovation and the number of others who have already adopted it. The number of adopters convinces potential adopters of an innovation's value through three distinct processes: strength of word of mouth, apparent legitimacy, and positive network externalities.

Word of mouth may alter the attractiveness of an innovation by making the potential adopter aware of the innovation and by permitting a vicarious trial (Burt 1987). Rather than having too little information available, most modern innovators have too much information. Identifying trustworthy others allows the potential adopter to cut search time (Coleman, Katz, and Menzel 1982). The knowledge that trusted others are considering an innovation is treated as an indication of its value. The more trustworthy or admired others who have adopted the innovation, the more likely that a potential adopter will hear of an innovation, including its consequences, through these informal channels. The intensity and quality of rhetoric promoting the innovation promotes conversion. For example, in a classic study of tetracycline use (Coleman, Katz, and Menzel 1982), the average

physician's preference for the new drug and the number of doctors who had already adopted the drug determined the diffusion rate; later studies added differing preferences and the non-uniform availability of information across social networks (Burt 1987). A system dynamics study of medical diffusion endogenized both actual and perceived performance (Homer 1987).

In the *word of mouth* loop, the more adopters there are, the stronger the word-of-mouth effect, and the more attractive the innovation. The process is self-reinforcing because the greater number of adopters that result further reinforces the strength of the word-of-mouth effect.

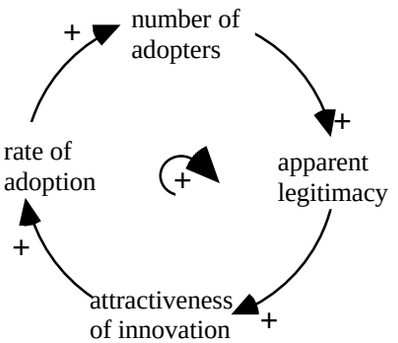
Figure 20: Word of mouth loop



Discussing an innovation with others allows a potential adopter to reach a normative understanding of the costs and benefits of adoption to people or firms in their social role (Burt 1987). A person risks embarrassment or sanctioning for being the last to adopt a practice that has become a feature of occupying a status. Potential resources or relationships may be withheld for failure to operate similarly to equivalent others.

Legitimacy is enhanced by being perceived as complying with standard practice as defined by the actions of competitors. Adoption is likely to be a weighted function of the innovation's objective merits and other's social behavior. The less certain a firm or individual is of the objective merits, the more heavily they weigh social information (Abrahamson and Rosenkopf 1993). The result is the positive feedback process represented in the *legitimacy of adopting* loop.

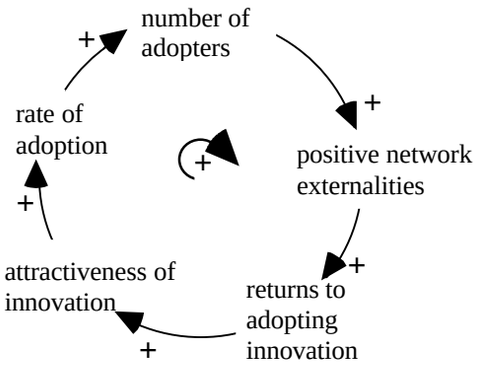
Figure 21: Legitimacy of adopting loop



Separately from social expenses, network externalities may drive up the rewards or cut the costs of adopting an innovation. Externalities—for example, production volume, availability of information or support, ease of access—that are a function of the number of current adopters affect the returns to following an innovation. Positive externalities escalate returns non-monotonically. For example, early entry into microprocessor production communities, which eventually had many participants, increased the market share of early adopters (Wade 1995). Communities with higher sales early on attract secondary sources which increase production capacity and make the market more

attractive (p. 129). Support for complementary products increases the market for the original product and may discourage competitors (p. 130).

Figure 22: Network externalities loop



Several factors can stop diffusion. The most obvious is the saturation effect: once most people have adopted the innovation, fewer are left to adopt it, and the rate of adoption necessarily slows. Sometimes people or firms reject an innovation because so many others have adopted it (see Abrahamson and Rosenkopf 1993 on counter-bandwagons). This snob effect may result in the introduction of fashion replacements. Alternatively, the arrival of a little information to some or all potential adopters or the possibility of a change in perceived value of an innovation may end the diffusion process (Bikhchandani, Hirshleifer, and Welch 1992). Just as localized patterns of conformity may start a diffusion chain, local patterns of dissent may break it.

Discussion: Comparing processes

What do we learn from mapping the positive feedback processes at work in a variety of organization theories? One idea unexplored in most of the existing theoretical work is that the processes may operate at a variety of levels of analysis. For instance, learning by doing may operate at the individual, group, organizational, institutional field, and societal levels, although the mechanisms may vary—clearly the social processes that strengthen organizational learning by doing cannot operate at the individual level, and learning at the institutional field level cannot rely on the same processes postulated for learning within organizations, since the mechanisms of selection and control within an organization are likely to be stronger than those within an industry. Another example is from the theory of institutional isomorphism: the normative, mimetic, and coercive processes that result in organizations within an industry growing more similar over time may well operate within organizations as individuals facing uncertainty about how to proceed draw on normative professional practices, mimic peers, or submit to the power of others and adapt their behavior accordingly. Further development and testing of these ideas will be instrumental in helping organizational scholars to build integrative, multi-level theories. It will also help to sharpen our understanding of the mechanisms by which such processes operate in organizations and organizational communities.

The juxtaposition of positive feedback processes is also suggestive of new research ideas. Taken together, the twenty-two feedback loops presented here describe a wide range of ways in which actions and decisions are reinforced in organizations and communities of

organizations. Assembling and comparing them suggests several avenues of research that could help us better understand how organizations change—or do not—over time.

In some situations, the feedback structures may interact with each other. For instance, once information-processing, psychological and interpersonal processes that generate escalation of commitment result in an organization's persisting with a course of action, social processes at work in diffusion and isomorphism could encourage other organizations to adopt the same course of action. Thus one set of processes may take over from another when a critical threshold has been reached—in this case, once the organization that is the early adopter achieves legitimacy as a result of its perseverance, it may be selected as a model to emulate by other organizations.

Another promising idea is that processes at one level may shape (or even generate) those at another level. For instance, norms and practices may spread throughout an organization as members uncertain of how to proceed emulate others. The sharing of norms may help further both learning by doing and the spread of culture and strengthening of socialization. Thus the learning-by-doing and culture-and-socialization feedback structures may rely on underlying processes of emulation described by mimetic isomorphism.

A further research suggestion concerns the association of processes. Once one self-reinforcing feedback structure is observed, researchers and practitioners may draw on the present collection of reinforcing processes to predict side-effects and additional feedback processes that may be associated with it. The present analysis also highlights links between

related feedback structures, suggesting that when one effect is discovered, others may be associated with it. Learning by doing is linked with institutional inertia, for example: as organizational members become better at implementing a chosen course of action, consistent organizational norms, policies, and procedures evolve in concert—this is part of the learning by doing process described above. As a result, the organization's ability to implement alternatives falls because the norms, policies, and procedures required to support alternative courses of action are atrophied or never develop, reflecting the inertia loop from escalation of commitment research. Thus the basic process of elaborating rules and norms to support one way of doing things results in both learning and inertia.

In addition, with more systematic exploration of the theories laid out here (and in particular with the formal modeling of processes posited to explain a given phenomenon), some feedback structures may be ruled out as explanations for the observed dynamics—a single reinforcing process may be enough to account for the observed history dependence. For instance, while the research on escalation of commitment proposes ten reinforcing processes to account for the tendency to persist with a losing course of action, only some of those processes may be present in a given situation.

While the present exercise of mapping and comparing reinforcing feedback structures in a variety of theories has generated intriguing proposals that may help explain change over time (or the lack of it) in organizations, our analysis also suggests ways in which system dynamics can make unique contributions to our understanding of organizations.

In particular, formulating simulation models to explore these processes will expose questions important in understanding how each operates and the situations in which each applies. What are the initial conditions that shape the system when the reinforcing process is getting established? What are the constraints that limit reinforcement? In other words, what are the negative feedback loops that balance the system? Could other processes act as substitutes? How do processes at one level—e.g., cognitive—interact with or generate those at another—e.g., organizational?

Testing and extending the feedback processes presented here will help the field of system dynamics identify a set of fundamental feedback structures that recur in a wide variety of social systems. Assembling and validating archetypal organizational processes is an important step in building a greater "culture of accumulation" (Richardson 1996). Because these processes operate at specific cognitive, psychological, social, and institutional levels, and because they are linked to theoretical an empirical research introduced here and documented in more detail elsewhere (see Sastry and Coen 1998 for a discussion of the related literature and a typology of the processes), they may offer a starting point for understanding the system dynamics of organizations that is more useful than the archetypes presented in the systems thinking literature.

The system dynamics approach may also help build understanding in the five areas of research identified above. As others extend and formalize the feedback loops presented here, the processes at work will be clarified and ambiguities and inconsistencies in the original research exposed. Building simulation models that incorporate the reinforcing

loops will validate the underlying theory in ways that complement traditional methods of other fields; and documenting other, interacting loops may help to extend the theories which often fail to explain the limits to self-reinforcing processes in organizations. The result will be an increase in the quality of organizational theory, better linkages between research in system dynamics and more traditional areas of organizational studies, and greater insight into the often vexing problem of resistance to change in organizations.

References

Abrahamson, E. 1996. Management fashion. *Academy of Management Review* 21 (1): 254-285.

Abrahamson, E., and L. Rosenkopf. 1993. Institutional and competitive bandwagons: Using mathematical modeling as a tool to explore innovation diffusion. *Academy of Management Review* 18 (3): 487-517.

Aldrich, H. 1979. *Organizations and environments*. Englewood Cliffs, NJ: Prentice Hall.

Argote, L., and D. Epple. 1990. Learning curves in manufacturing. *Science* 247: 920-924.

Argote, L., S. L. Beckman, and D. Epple. 1990. The persistence and transfer of learning in industrial settings. *Management Science* 36: 140-154.

Arkes, H. R., and C. Blumer. 1985. The psychology of sunk cost. *Organizational Behavior and Human Decision Processes* 35*:* 124-140.

Bellinger, G. 1998. *Archetypes: Interaction structures of the universe*. World wide web site: www.radix.net/crbnblu/musings/arch/arch.htm.

Bikhchandani, S., D. H. Hirshleifer, and I. W. Welch. 1992. A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of Political Economy* 100 (51): 992-1026.

Boeker, W. 1988. Organizational origins: Entrepreneurial and environmental imprinting at the time of founding. In *Ecological Models of Organizations,* ed. G. Carroll (pp. 33-51). Cambridge, MA: Ballinger Publishing.

Boeker, W. 1989a. The development and institutionalization of sub-unit power. *Administrative Science Quarterly* 34: 388-410.

Boeker, W. 1989b. Strategic change: The effects of founding and history. *Academy of Management Journal* 32 (3): 489-515.

Brockner, J. 1992. The escalation of commitment to a failing course of action: Toward theoretical progress. *Academy of Management Review* 17 (1): 39-61.

Burt, R. S. 1987. Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology* 92 (May): 1287-1335.

Coleman, J. S., E. Katz, and H. Menzel. 1982. *Medical Innovation: A Diffusion Study*. Indianapolis: Bobb-Merrill.

DiMaggio, P. J., and W. W. Powell. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociology Review* 48*:* 147-160.

Dowling, A. M., R. H. MacDonald, and G. P. Richardson. 1995. Simulation of systems archetypes. *Proceedings of the 1995 International System Dynamics Conference, Tokyo*. Lincoln MA: System Dynamics Society.

Eisenhardt, K. M., and C. B. Schoonhoven. 1990. Organizational growth: Linking founding team, strategy, environment, and growth among U.S. semiconductor ventures, 1978-1988. *Administrative Science Quarterly* 35: 504-529.

Forrester, J. W. 1980. System Dynamics—Future opportunities. In *System Dynamics*, ed. Legasto, A. A., J. W. Forrester, and J. M. Lyneis, TIMS Studies in Management Science, vol. 14. New York: North-Holland.

Garland, H. 1990. Throwing good money after bad: The effect of sunk costs on the decision to escalate commitment to an ongoing project. *Journal of Applied Psychology* 75*:* 728-731.

Garud, R., and M. A. Rappa. 1994. A socio-cognitive model of technology evolution: The case of cochlear implants. *Organization Science* 5 (3): 344-362.

Goodman, M., and J. Kemeny 1994. Applying an archetype. In *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*, ed. P. M. Senge, A. Kleiner, C. Roberts, R. B. Ross, and B. J. Smith: 121-125. New York: Doubleday.

Hannan, M. T., and J. Freeman. 1984. Structural inertia and organizational change. *American Sociology Review* 49*:* 149-164.

Heath, C. 1995. Escalation and de-escalation of commitment in response to sunk costs: The role of budgeting in mental accounting. *Organizational Behavior and Human Decision Processes* 62 (1): 38-54.

Homer, J. B. 1987. A diffusion model with application to evolving medical technologies. *Technological Forecasting and Social Change* 31: 197-218.

Kim, D. H. 1996. Systems archetypes: Diagnosing systemic issues and designing high-leverage interventions (reprinted from Toolbox Reprint Series: Systems Archetypes, Cambridge MA: Pegasus Communications). In *Modelling for Management 1: Simulation in Support of Systems Thinking*, ed. G. P. Richardson: 153-164. Aldershot UK: Dartmouth.

Kimberly, J. 1979. Issues in the creation of organizations: initiation, innovation and institutionalization. *Academy of Management Journal* 22 (4): 37-457.

Lane, D. C., and C. Smart. 1996. Reinterpreting 'generic structure': evolution, application and limitations of a concept. *System Dynamics Review* 12 (2): 87-120.

Mashayekhi, A. N. 1993. Transition in the New York State solid waste system: a dynamic analysis. *System Dynamics Review* 9 (1): 23-47.

Masuch, M. 1985. Vicious circles in organizations. *Administrative Science Quarterly* 30: 14-33.

Mintzberg, H., and J. Waters. 1982. Tracking strategy in an entrepreneurial firm. *Academy of Management* 25 (3): 465-499.

Morecroft, J. D. W. 1982. A critical review of diagramming tools for conceptualizing feedback system models. *Dynamica* 8 (1): 20-29.

Naill, R. F. 1992. A system dynamics model for national energy policy planning. *System Dynamics Review* 8 (1): 1-19.

Nelson, R. B. 1994. The co-evolution of technology, industrial structure, and supporting institutions. *Industrial and Corporate Change* 3 (1): 47-63.

Nelson, R. R., and S. G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.

Richardson, G. P. 1986. Problems with causal-loop diagrams. *System Dynamics Review* 2 (2): 158-170.

Richardson, G. P. 1991. *Feedback Thought in Social Science and Systems Theory*. Philadelphia: University of Pennsylvania.

Richardson, G. P. 1996. Problems for the future of system dynamics. *System Dynamics Review* 12 (2): 141-157.

Rogers, E. M. 1983. *Diffusion of Innovations*. New York: Free Press.

Romanelli, E. 1989. Environments and strategies of organizational start-up: Effects on early survival. *Administrative Science Quarterly* 34 (3): 369-387.

Ross, J., and B. M. Staw. 1993. Organizational escalation and exit: Lessons from the Shoreham nuclear power plant. *Academy of Management Journal* 36 (4): 701-732.

Sastry, M. A. and C. Coen. 1998. Tracing the hand of the past: Towards an integrated theory of how history matters in organizations. *Working paper*. University of Michigan Business School.

Schein, E. H. 1983. The role of the founder in creating organizational culture. *Organizational Dynamics* 12: 13-28.

Senge, P. M. 1990. *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday.

Senge, P. M., A. Kleiner, C. Roberts, R. B. Ross, and B. J. Smith. 1994. *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*. New York: Doubleday.

Staw, B. M. 1976. Knee deep in the big muddy: A study of escalating commitment to a chosen course of action. *Organizational Behavior and Human Performance* 16: 27-44.

Staw, B. M. 1981. The escalation of commitment to a course of action. *Academy of Management Review* 6: 577-587.

Staw, B. M., and H. Hoang. 1995. Sunk costs in the NBA: Why draft order affects playing time and survival in professional basketball. *Administrative Science Quarterly* 40: 474-494.

Staw, B. M., and J. Ross 1987. Behavior in escalation situations: Antecedents, prototypes, and solutions. In *Research in Organizational Behavior,* ed. B. M. Staw and L. L. Cummings: 39-78. Greenwich, CT: JAI Press.

Staw, B. M., and J. Ross. 1978. Commitment to a policy decision: A multi-theoretical perspective. *Administrative Science Quarterly* 23: 40-64.

Staw, B. M., and J. Ross. 1989. Understanding behavior in escalation situations. *Science* 246: 216-220.

Sterman, J. 1994. Beyond training wheels. In *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization,* ed. P. M. Senge, A. Kleiner, C. Roberts, R. B. Ross, and B. J. Smith: 177-183. New York: Doubleday.

Sterman, J. D., and G. P. Richardson. 1985. An experiment to evaluate methods for estimating fossil fuel resources. *Journal of Forecasting* 4: 197-226.

Sterman, J. D., N. P. Repenning, and F. Kofman. 1997. Unanticipated side effects of sucessful quality programs: Exploring a paradox of organizational improvement. *Management Science* 43 (4): 503-521.

Stinchcombe, A. L. 1965. Social structure and organizations. In *Handbook of Organizations,* ed. J. G. March: 153-193. Chicago, IL: Rand McNally.

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

Valente, T. W. 1995. *Network Models of the Diffusion of Innovations*. Cresskill NJ: Hampton Press.

Van de Ven, A., and R. Garud 1994. The coevolution of technical and institutional events in the development of an innovation. In *The Evolutionary Dynamics of Organizations,* ed. J. A. C. Baum and J. Singh: 425-443. Oxford: Oxford University Press.

Wade, J. 1995. Dynamics of organizational communities and technological bandwagons: An empirical investigation of community evolution in the microprocessor market. *Strategic Management Journal* 16: 111-133.